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May 29, 2020

Mr. Patrick Wruck
Commission Secretary and Manager
Regulatory Support
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Wruck:

RE: British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
COVID-19: Emergency Response and Wildfires Mitigation Plans

BC Hydro writes in response to the Commission's correspondence of May 7, 2020, in which the BCUC asked that the following documents be filed with the BCUC[1]:

1. An updated Utility Emergency Response Plan modified to address foreseeable challenges posed by the COVID-19 pandemic (Pandemic). These updated plans should address emergency response plans for situations including, but not limited to, wildfires, floods, windstorms, cyber-attacks and earthquakes. A discussion of planned tabletop exercises scheduled in the next 12 months should also be included, if any.
2. A Utility Wildfire Mitigation Plan, including discussions of the Utility's internal processes and policies to prevent wildfires, as well as any modifications to regular operational protocols to address challenges posed by the Pandemic.

1 BC Hydro's Emergency Response Plan

Our ability to manage other emergencies has not been impacted by the current Pandemic circumstances and our emergency response plans remain unchanged. In fact, in early April, BC Hydro successfully responded to a significant forest fire in close proximity to our assets in the Squamish area.

BC Hydro has a Corporate Emergency Response Plan (**the Plan**), which outlines our framework and defines our structure during emergency situations (the Plan is provided as **Attachment 1** to this response), with the exception of sections 6 and 7 of the Plan,

[1] Per BCUC Letter of May 7, 2020: British Columbia Hydro and Power Authority, FortisBC Inc., FortisBC Energy Inc. and Pacific Northern Gas (N.E.) Ltd. – COVID-19: Emergency Response and Wildfires Mitigation Plans.

which are not provided as they include staff names. This Plan was activated at the onset of the current Pandemic situation. In addition, BC Hydro has an annex to the Plan, titled the Pandemic Annex, which outlines our strategies and principles during a Pandemic. The Pandemic Annex was filed with the BCUC as part of the Fiscal 2020 to Fiscal 2021 RRA.[2]

To-date, our response to the COVID-19 virus has proven to be effective, and BC Hydro has avoided the spread of COVID-19 amongst our workforce. BC Hydro has taken several steps to keep our crews working at a distance and focussed on critical or emergency work. This strategy has kept our crews healthy and prepared to respond as needed, in the event another emergency occurs. In emergency situations, our crews will continue to work safely whether through physical distancing or the use of adequate personal protective equipment and our emergency centres are set-up to operate virtually.

Supplementing our Corporate Emergency Response Plan are a number of plans to coordinate response to other hazards such as flooding, wildfire, storms, earthquakes, as well as cyber-security attacks. These plans have been unchanged through the COVID-19 situation.

Planned Exercises

This year BC Hydro will participate in the British Columbia ShakeOut exercise in October to test our earthquake response capabilities. Regarding cyber security preparedness, BC Hydro completed the GridEx exercise in November 2019 and our Technology department is currently reviewing potential cyber security exercise scenarios to test our cyber security plan this fall.

2 BC Hydro Wildfire Mitigation Plan

BC Hydro does not currently publish a unified Wildfire Mitigation Plan document. However, we have well-established and robust procedures and work practices in place to mitigate wildfire risks and impacts across our service area, and these have been developed to ensure that BC Hydro remains in compliance with the BC *Wildfire Act*. Details are captured in the following documents:

- *T&D Asset Management Framework* (provided as **Attachment 2**) lays out BC Hydro's overall approach to asset management and outlines the activities related to the sustainment of each of the various asset classes. Implementation of this framework and the asset strategies reduce the likelihood of BC Hydro's equipment igniting wildfires.

2 Exhibit B-58, Response to Undertaking Number 44 - BC Hydro Pandemic Response Plan Annex outlining response to a potential pandemic such as Influenza or COVID-19.

- *T&D Wildfire Hazard Strategy* (provided as **Attachment 3**) details BC Hydro's strategy for managing the wildfire risk using the asset management framework.
- *Wildfire Response Procedure* (provided as **Attachment 4**) provides to BC Hydro's front-line crews and contractors the procedures they are to follow in the event of a wildfire.
- The *Corridor Integrated Vegetation Management Program* (provided as **Attachment 5**) contains a detailed description of the main aspects of BC Hydro's vegetation management program.

BC Hydro's overall approach to mitigating wildfire risk includes managing both the probability and the consequence components of the risk. The approach includes:

- Reducing the likelihood of BC Hydro's activities and equipment igniting fires (crew awareness, procedures during high fire danger times, identification and repair of defects, designing infrastructure to minimize ignition risk);
- Reducing the impact to the power system if a fire does occur (designing resilient infrastructure, minimizing damage and outages, training, tools, and emergency response planning);
- Reducing the severity of fires should one occur (system and equipment design, intensity and rate of spread by managing fuels/vegetation); and
- Consideration of lessons learned and experiences of other jurisdictions.

BC Hydro continuously manages the fire risks in our operational activities as explained below.

Mitigation of Risk for Operational Activities

For transmission and distribution lines, various aspects of our growth projects and sustainment work plans address fire risk. The following are examples of how fire risk is managed across a number of operational activities:

Adding assets to the system: Effective fire risk management begins with the planning that occurs when new assets are added to the system. The asset decisions made during the design and construction of a growth project greatly influence the ability to efficiently and effectively manage fire risks for the operational life of the asset. Aspects that influence this include: line route selection, access planning, structure selection, material selection, electrical design, access and clearing standards, construction quality control, the land rights for the project, and commitments made to third parties that influence clearing and access.

Sustaining existing assets: The key mechanisms by which fire risks are managed for our existing assets are: through the consistent application of BC Hydro's Maintenance Standards (including inspections and condition-based maintenance), the maintenance levels and sustaining capital investments applied to the system, and the prioritization of the work plans (for both condition-based maintenance and the sustaining capital investments) to perform the highest priority work first.

Line maintenance: The line maintenance programs address fire risk through routine inspections and condition-based repairs on the system, for example including insulator and crossarm replacements; ensuring that grounding and bonding is installed as designed and intact; and for higher-voltage transmission lines, applying grounds to wire fences located under extra-high voltage transmission lines. The maintenance programs also include the Properties Referral Process, where public uses of BC Hydro's rights of way are regulated to ensure safety, including addressing potential fire hazards associated with third party activities in proximity to the power system. Finally, the maintenance programs also provide the inputs necessary for planning the end-of-life capital investments on the system, to replace aging assets before they fail.

Vegetation maintenance: The vegetation maintenance programs are designed to reduce the risk of ignition by removing vegetation growing too close to the conductors, as well as removing hazard trees adjacent to the power lines to reduce the occurrence of trees falling into the conductors. The program also reduces the overall fire risk by managing the fuel loading generated by the vegetation control program, so that if a fire does occur it is of lower severity and does not spread as fast or as far. For the transmission system, BC Hydro is subject to additional regulation under the NERC Mandatory Reliability Standard FAC-003-4.

Fire risk modelling: BC Hydro has previously modelled the high-risk fire areas for the transmission system. We are in the process of refreshing this risk model, with coverage extended to include all transmission, distribution and generation assets. The updated model is scheduled to be available by the end of Fiscal 2021 (March 31, 2021). This modelling informs additional prescribed work and investments on the system (such as use of alternatives to wood, or improvements to the distribution protection equipment). The modelling does not predict where future fire events will occur, and so certain key maintenance practices are designed to reduce the risk across the entire system.

Standard Operating Procedures: For field employees and contractors, BC Hydro also ensures that workers who are performing high-risk work in forest and urban interface lands are aware of wildfire risk, and the requirements for wildfire preparedness as required by the provincial regulations. This includes crews performing daily checks of the fire danger rating for the work areas, documenting wildfire risk aspects in daily tailboard meetings, and ensuring crews have appropriate tools and training to be able to correctly respond if a fire is accidentally ignited at their worksite.

System operations: In times of extreme fire hazard, the potential of wildfire ignition by distribution lines is reduced by blocking reclosing control on circuits under rules of *Distribution Operating Order 1D-51* (provided as **Attachment 6**). The operating order seeks to balance the risk of wildfire ignition with keeping the power on to as many customers as possible.

Wildfire mitigation activities are a critical function and have continued on pace, despite the pandemic.

Conclusion

Our existing emergency response and wildfire mitigation plans remain unchanged in light of the current Pandemic situation. However, BC Hydro has adapted work practices in response to the Pandemic. To-date, steps have been taken to keep our crews working at a distance and focus on critical or emergency work. This strategy has kept our crews healthy and prepared to respond as needed, in the event an emergency were to occur. In emergency situations, our crews will continue to work safely, whether through physical distancing or the use of adequate personal protective equipment.

BC Hydro's practices and procedures for managing wildfire risk are well established and going into the 2020 fire season we are well prepared to appropriately manage all the aspects of wildfire risk related to our system work.

For further information, please contact the undersigned.

Yours sincerely,

Fred James
Chief Regulatory Officer

bh/af

Enclosure

COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 1

Corporate Emergency Response Plan

BC HYDRO

EMERGENCY RESPONSE PLAN

AUTHORIZATION

Approved by:

Chris O'Riley
President & Chief Executive Officer

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INITIAL RESPONSE ACTION TABLE

ACTIONS FOLLOWING A MAJOR EVENT (i.e. major earthquake on BC Coast)

All employees are responding to their immediate situation, following field, site or business unit emergency plans and/or operating orders. Employees without a response role or business unit emergency plan are following BC Hydro Incident Command team instructions (if at work) and Know Your Role procedure (described in Employee Initial Earthquake Response video). Acronyms are defined in Appendix I.

STEP	ACTION	RESPONSIBILITY
1	Ensure your and your family's personal safety.	All employees
2a	Self-deploy immediately to the Emergency Coordination Centre at Horne Payne Office, 1833 Gilmore Avenue, Burnaby Reply to BCH emergency alert(s)	ECC Initial Response Staff (IRS), *refer to Appendix A*
2b	Follow SOP to send BC Hydro alerts to: a) IRS confirming deployment to ECC and status checks will commence on emergency conference bridge b) Executive team confirming availability to perform executive role c) All employees confirming a major event has occurred and the BCH response structure has been triggered	Security Command Centre (SCC)
2c	On top of every even hour (i.e. 8am, 10am…) join IRS emergency conference bridge, until sufficient contact established: Primary: **1-877-708-3350** Access Code: **3529033#**	ECC IRS Led by Duty Coordinator and Emergency Manager
2d	Wait for instructions on ECC activation, reporting, emergency role assignment and deployment to the ECC. ECC staff will be contacted by phone / email by a member of Initial Response Staff or Security Command Centre. Your manager may also deploy you.	All ECC staff, *refer to Appendix B*
3	Participate in Business Unit Team Check-in as described in team response procedures. Gather employee status and prepare to report this information through emergency centre response structure (i.e. local, regional, corporate reporting channels). Continue responding personally to your situation as per response	All employees

<table>
<tr><th>STEP</th><th>ACTION</th><th>RESPONSIBILITY</th></tr>
<tr><td></td><td>role and instructions.</td><td></td></tr>
<tr><td>4</td><td>Upon arrival at ECC, follow ECC Activation Procedures to:

1. Confirm with Horne Payne Incident Commander the building is safe to occupy
2. Communicate activation of ECC
3. Deploy people to, and set them up in the ECC
4. Assign roles
5. Initiate assessments and gather situational information
6. Arrange initial coordination call (#1)

IRS may perform actions virtually as they transit to the ECC.

Notifications communicated through any available channels: Send Word Now/email/phone/text/radio

Refer people to position checklists and job-aids (Section 8 and physically at the ECC)</td><td>Led by Emergency Manager

Completed/ supported by Initial Response Staff (IRS)</td></tr>
<tr><td>5</td><td><u>Conduct ECC Initial Coordination Call (#1)</u>:
- Use job-aids
1. obtain and confirm initial information and status from local staff, RTO, PSOSE, Incident Commanders, other emergency centres, ECC section leads, and external sources
2. assess impacts and system functionality (employees, dams, operations, communications, technology, buildings, etc.)
3. review roles (Org Chart) and staffing level to support the event
4. set immediate objectives and response priorities, confirm actions being taken</td><td>Chaired by ECC Director

Attended by assigned ECC members, regional and local Emergency Centre staff, and Incident Commanders at corporate sites

Optional attendance: President, Executives</td></tr>
<tr><td>6</td><td>Call-inadditional ECC staff.</td><td>Assigned ECC members</td></tr>
</table>

STEP	ACTION	RESPONSIBILITY
7	Set and communicate ECC deliverables and schedule of activities for next 24 hours (Operational Period, Coordination Calls, Executive Briefings, Situation Reporting, Contact lists, Shift Change schedule). Document situation and actions taken. Post information here: Emergency Event Response Refer to Generic and Position Checklists for guidance (Section 8).	ECC Director / Manager / Planning Lead / Situation Lead
8	Complete 1st shift deliverables/activities, following ECC Procedures. Prepare for next shift or hand-over.	ECC staff
End of 1st Operational Period / Initial Phase. Enter ECC Operational Phase.		

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Version Control and Plan Updates

Date	Details about exercises/activation/revision	Updated by	Approved by
Jan 28, 2015 Version 1.0	ERP approved & implemented	[redacted]	[redacted]
June 30, 2015 Version 1.1	Semi-annual review & update Addition of company's electrical system and technology restoration priorities (section 2.02). Addition of position checklists (section 7)	[redacted]	[redacted]
January 1, 2016 Version 1.2	Annual review & update	[redacted]	[redacted]
May 18, 2016	Updated conference bridge numbers	[redacted]	[redacted]
July 22, 2016 Version 1.3	Annual review & signature	[redacted]	[redacted]
2017-18	Updates throughout	[redacted]	
October 2019 Version 2.0	Updates throughout	[redacted]	[redacted]
November 2019	Updated Finance staff in Appendix B	[redacted]	[redacted]
May 2020	Updated Technology (IT) information	[redacted]	

Location/Document Storage and Availability

Hardcopy Distribution
BC Hydro Emergency Coordination Centre (primary location)
Electronic Location
October 2019: moved to posting on Security and Emergency Management Hydroweb; Response / Plans and Procedures
Access
This plan is available to all employees through Hydroweb
Responsibility for the above: [redacted]

Section 1. OVERVIEW

1.01 Introduction

BC Hydro's Emergency Response Plan (ERP) provides a framework, defines the structure and roles and responsibilities for BC Hydro to respond to and recover from major events or emergencies that affect or have affected safety, or BC Hydro's services, operations, assets, reputation, or the environment.

The Provincial (British Columbia) *Emergency Program Act* describes an emergency as "a present or imminent event or circumstance that is caused by accident, fire, explosion, technical failure or the forces of nature and requires prompt coordination of action or special regulation of persons or property to protect the health, safety or welfare of a person or to limit damage to property."

This plan adheres to BC Hydro's Security and Emergency Management Policy which outlines requirements for preparedness and response.

Security and Emergency Management's Governance Manual describes the BC Hydro Emergency Management Program overall, and the emergency management system at all levels of the company.

Note that this plan is in the context of *Emergency Program Act* and the *Hydro and Power Authority Act* which set out the responsibilities of organizations involved in the management of emergencies.

Questions, errors and required amendments

Should you have questions about this document, notice errors or have suggestions for the improvement of the plan, please contact Emergency Management via email at emergency_management@bchydro.com

1.02 Purpose

This plan outlines how BC Hydro will coordinate and respond to planned or unplanned incidents that have impacted, or could potentially have impacts to, our services, operations, safety of the public or our workers, reputation, and/or the environment.

1.03 Out of Scope

This plan does not describe tactical actions to be taken for specific emergencies. Such actions are detailed, for example in local emergency response / action plans, operating orders, business continuity plans and/or technology disaster recovery plans.

All plans and emergency protocols are written to align and/or reference one another in order for employees to have non-conflictingand clear protocols to follow.

Site and business unit plans, and stand-alone procedures can be found on Emergency Management's share point site. Operating Orders are available on Controlled Document Filenet Search (CDFS) and Site Information System (SIS).

Section 2. EMERGENCY RESPONSE STRUCTURE & REPORTING

2.01 Emergency Management System and Response Structure

BC Hydro utilizes the Incident Command System[1] (ICS) and British Columbia's Emergency Management System[2] (BCEMS) to manage emergency situations. Incident command is established at site and requires reporting to the Security Command Centre or Duty Coordinator for notifications to be sent key stakeholders. In cases of high severity incidents the Duty Coordinator facilitates response which may include the assessment on the level of emergency centre activation required.

Depending on the level and scope of the incident, BC Hydro may use Incident Command Posts, local Emergency Operations Centres (EOC) and/or Regional Emergency Operations Centres (REOC). Alternatively the Emergency Coordination Centre (ECC) can be activated and operate in a scaled down / virtual version to manage a local or regional emergency through incident command without activating an EOC or REOC. The response structure is scalable and flexible to accommodate the changing response needs of all emergency situations. BC Hydro will activate the ECC for incidents that impact more than one region, involve multiple business units or sites, and for those incidents which are of a severe nature.

At all times, employees across the organization have dedicated emergency event roles. As emergency centre(s) are activated, these roles continue to function with support of the response structure. Figure 1 provides an overview of the BC Hydro emergency response structure.

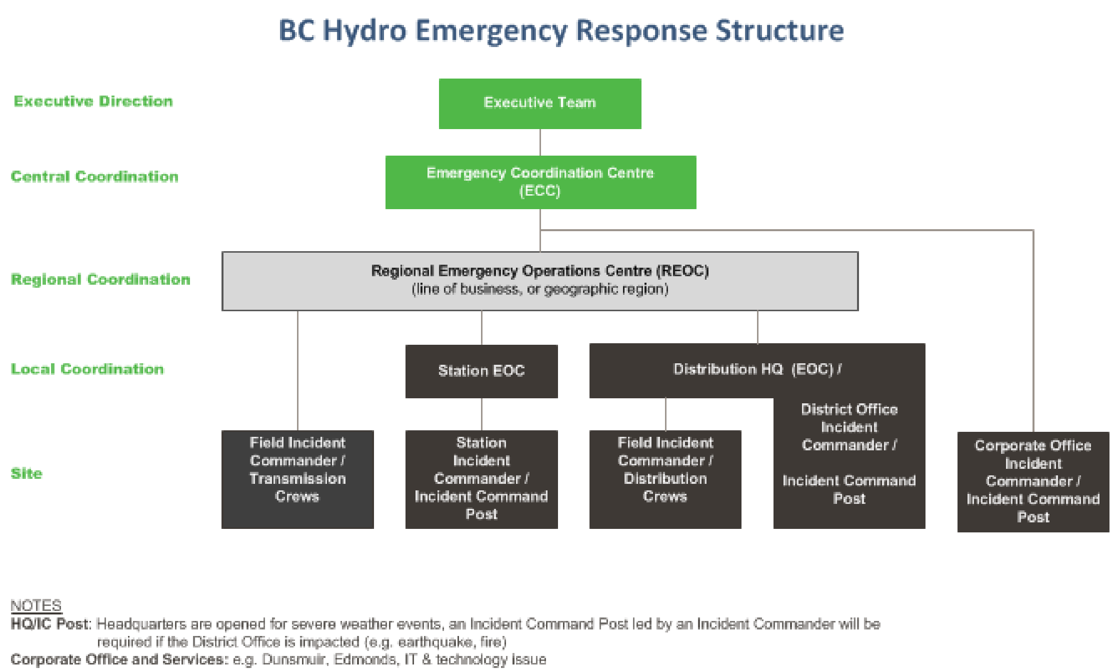


Figure 1: BC Hydro's emergency response structure

[1] The Incident Command System (ICS) is a standardized on-site management system designed to enable effective, efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. The ICS is used to manage an incident or a non-emergency event.

[2] British Columbia Emergency Management System (BCEMS) is recognized as a standard system for emergency response, and currently mandated for use within the Government of B.C. and recommended to local authorities.

2.02 Emergency Response Priorities

In general order, BC Hydro's response and restoration priorities are listed below. Judgment needs to be applied when prioritizing the goals.

- Provide for the safety and health of BC Hydro employees
- Provide for the safety and health of the public
- Protect and restore BC Hydro infrastructure and facilities
- Support restoration of critical infrastructure
- Protect the environment
- Reduce economic and social impacts to BC Hydro, its employees and its customers

(a) Power System and Circuit / Customer Priorities

Priorities for power system restoration follow the general guidelines below. Refer also to Operating Order 6T-26 (BC Hydro Restoration Plan) and subordinate Operating Orders.

Power System

- Water conveyance: dams, powerhouses, power and communications control centres and associated civil structures
- Voice communications and communications systems associated with protective functions from the bulk transmission system
- Transmission lines associated with the bulk transmission system and associated switching stations
- Station services at critical substations and plants
- Substations serving customer loads and bulk customers
- Distribution feeders
- Individual services

Critical or Priority Circuits / Customers

- Public Safety / Emergency Reception Centre (i.e. schools, civic centres)
- Hospital
- Police / RCMP / Border Crossing
- Fire / Ambulance
- Provincial and municipal emergency centres and their services facilities such as fire supply pumping stations
- Facilities as directed by municipal, provincial and/or federal emergency authorities
- Critical infrastructure providing essential services (utilities, telecommunications) and transportation routes (air, water, road, rail)
- Vulnerable populations, special needs customers (i.e. community care centres, senior centres, well water customers)
- General residential, commercial and industrial customers

(b) Technology and Critical Applications

Priorities for restoration of technology infrastructure and critical applications follow the general guidelines below. Refer also to Technology’s Service Continuity Plan, Major Incident Management Plan, Data Centre Disaster Recovery Plan and Cyber Security Incident Response Plan for further details, information and procedures.

Technology Infrastructure and Critical Applications

- Infrastructure Management
- Communications including system control and radio systems
- Identity & Access Management
- Network Operations
- Applications Support
- Security Management
- Cyber Security Management
- Regulatory Compliance
- Records Management
- Support Service Management

(c) Continuity of BC Hydro critical functions

Priorities for continuing BC Hydro’s critical functions not listed under a) the power system or b) technology infrastructure and critical applications, are the following, as identified through business continuity processes.

- Sustain supply chain of equipment, supplies, fleet and other resources critical for maintaining organizational critical functions
- Sustain critical human resource functions
- Perform system metering, analysis and processing of wholesale settlement - including Powerex
- Maintain revenue stream including: “Meter to cash” process
- Maintain critical Asset Management process

2.03 Duty Coordinator Role

A Duty Coordinator and Emergency Manager are available to respond to any emergency that may require support or coordination. They are responsible for notifying the Executive Team and Senior Management and form part of the ECC Initial Response Staff following a disaster.

The Duty Coordinator:

- Gathers initial details of the incident or imminent risk
- Sends notifications and activations to key stakeholders

- Gathers key stakeholders to confirm details on the situation, impacts or risks
- Provides initial support to the incident commander on site
- Determines the need for and level of emergency centre to be activated
- Initiates timely and centralized executive reporting
- Retains or assigns ongoing executive reporting responsibility until conclusion of the incident

The Duty Coordinator may support activation of the BC Hydro Emergency Coordination Centre (ECC) as outlined in Section 3.01.

2.04 Emergency Coordination Centre Role

The Emergency Coordination Centre (ECC) role is to:

- Manage a coordinated BC Hydro response to actual or imminent emergencies
- Provide strategic oversight and direction on BC Hydro's response
- Coordinate resource assignment and other logistical needs
- Communicate, report and liaise, including to the President and Executive Team
- Coordinate the recovery

The ECC has full responsibility to make decisions related to managing the emergency situation.

*Note that the Director of Dam Safety, as assigned by the Senior Vice President, Integrated Planning, is responsible to provide direction (including to the ECC Director) for the managed response to **dam safety** incidents and to elevate decisions to the President and Board and to report decisions to the Comptroller of Water Rights, if necessary, as outlined in the Dam Safety Governance Manual*

2.05 Emergency Coordination Centre Reporting

The ECC reports to the President and Executive Team (or delegates) when activated. The ECC organization chart outlines common internal reporting lines during ECC activations.

BC Hydro coordinates response and recovery with four broad categories of external organizations (figure 2 shows how BC Hydro liaises with these organizations during an emergency situation):

1. ***Government and key agencies*** such as Emergency Management BC, the Ministry of Energy and Mines, Comptroller of Water Rights, local municipalities and regional districts
2. ***Service providers*** to BC Hydro
3. ***First Nations***
4. ***Key stakeholders*** such as Key Account customers, and critical infrastructure owners (e.g. FortisBC, TELUS, Bell)

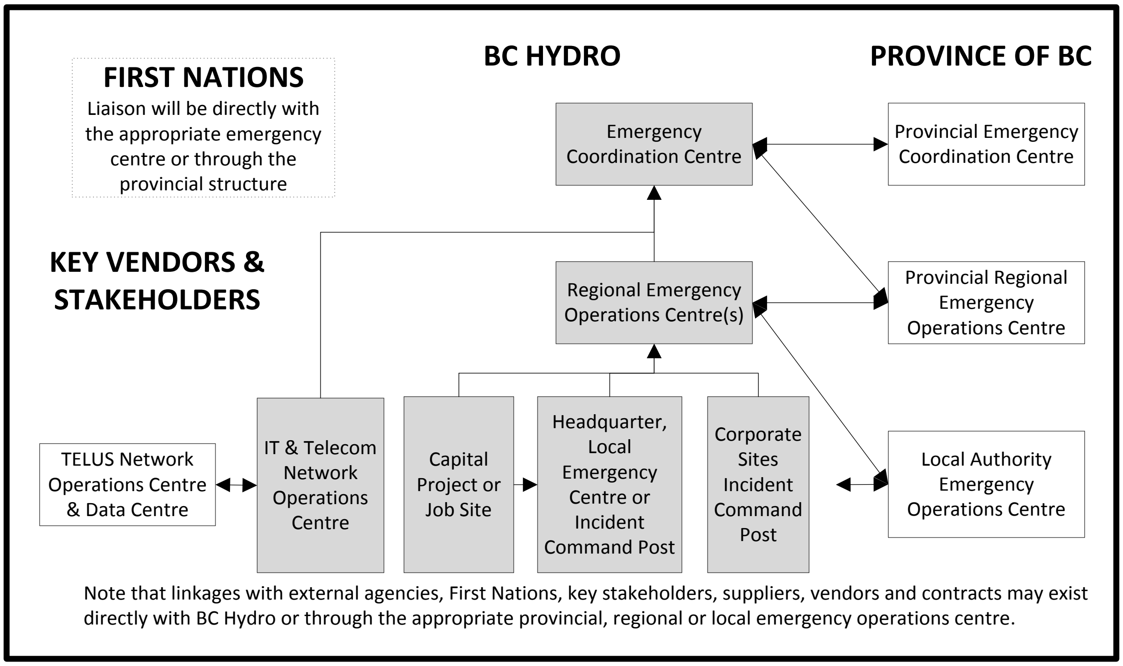


Figure 2: Liaison with provincial, First Nations, external agencies, and key vendors and suppliers

At all times the BC Hydro EM team maintains situational awareness communications with Emergency Management BC (EMBC). During ECC activations EM will act as ECC Emergency Manager and will liaise (or coordinate liaison) with local EOC, PREOC, or PECC, as needed. During a major emergency or disaster the liaison role will be assigned to subject matter experts across BC Hydro, depending on the type and severity of the event. The liaison role does not include response coordination authority for BC Hydro and when assigned, will report to the BC Hydro ECC (or REOC).

Liaison with IBEW and MOVEUP

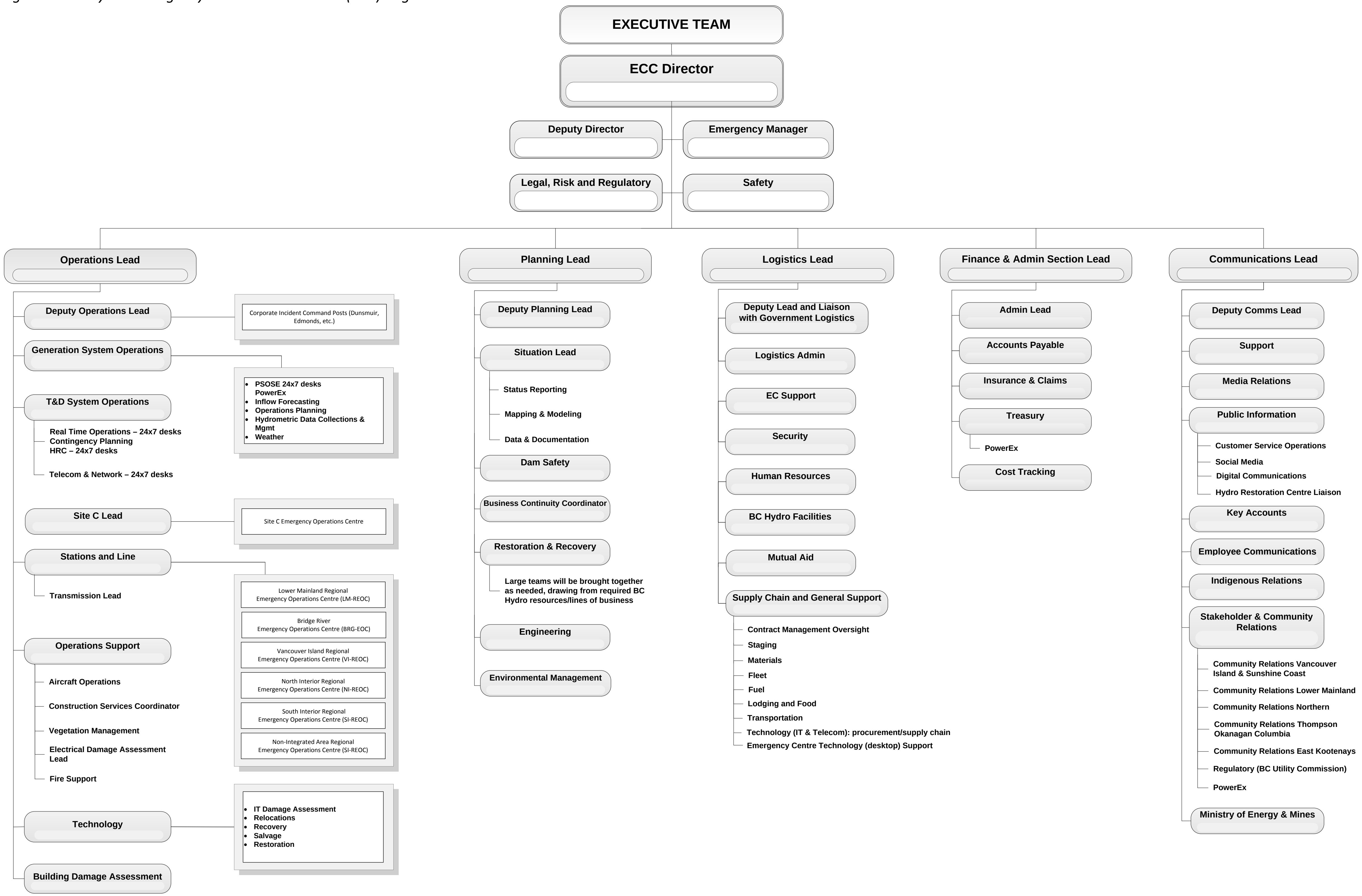
Notification of incidents and the BC Hydro response to IBEW and MoveUp will occur depending on the severity and type of incident, and impacts to Union members. Ongoing liaison will be event specific and determined at the time. The emergency centre director approves liaison and messaging.

2.06 Emergency Coordination Centre Organization

Figure 3 shows the complete ECC organization structure and its linkages to regional emergency operations centres within BC Hydro. The ECC organization will be scaled up or down depending on the type and duration of event. Descriptions of the role and responsibility of key ECC positions are found in Table 2 (Section 4.02).

Individuals assigned to ECC roles and their contact information is listed in Appendix B, and entered in Send Word Now for BC Hydro alerting purposes. General expectations for ECC staff are listed in Appendix F.

Figure 3: BC Hydro Emergency Coordination Centre (ECC) Organization Chart



2.07 Emergency Coordination Centre Facility

The **primary ECC** is located at the Horne Payne Office, Burnaby. During a major emergency, it is expected that the entire 2nd floor space will be utilized by ECC staff and seating/areas are pre-assigned to positions. There are meeting break out rooms, overflow/spare work stations, a radio communications station, First Aid facilities, a kitchen and shower facilities.

Emergency supplies on site (i.e. food, water, power sources, bedding, etc.).

Day to day, a smaller secure designated “turn-key” space with equipment, supplies, and technologies is maintained in a preparedness state. It requires minimal time to set-up and occupy (<30 min). Color-coded signage is used to identify locations for ECC staff to sit/work.

All ECC staff are expected to wear personal identification. ECC management and leads are expected to wear identification that clearly identifies their ECC role (i.e. vests).

ECC staff are also expected to communicate electronically via e-mail address allocated to the ECC role they are assigned to (as opposed to their regular BC Hydro e-mail address). This is to maintain continuity and clarity of communications.

The ECC section color-codes and position emails are outlined in table 1.

Position	Color	Email
Director	Green	ECC-Director@bchydro.com
Manager, Safety, Security, Legal	Red	ECC-Manager@bchydro.com ECC-Safety@bchydro.com ECC-Security@bchydro.com
Operations Section	Orange	ECC-Operations@bchydro.com ECC-Ops_Generation@bchydro.com ECC-Ops_Grid_Ops@bchydro.com ECC-Ops_Trans_Distrib@bchydro.com ECC-Ops_Technology@bchydro.com ECC-Ops_Support@bchydro.com ECC-Ops_Faciliites@bchydro.com
Planning Section	Blue	ECC-Planning@bchydro.com ECC-Situation@bchydro.com
Logistics Section	Yellow	ECC-Logistics@bchydro.com
Finance & Administration Section	Grey	ECC-Finance@bchydro.com
Information & Liaison Section	Purple	ECC-Info_Liaison@bchydro.com

Table 1: ECC color-codes and position emails.

The **alternate ECC** is located at Fraser Valley Office, Langley (main floor boardroom). The ECC Director will determine whether or not the alternate ECC will be used. If the alternate ECC is being activated, staff should report to the on-site security for facility check-in. The alternate ECC requires 60 – 120 minutes of set-up as it is not a “turn-key” facility.

2.08 ECC Maintenance, Information & Resource Material

ECC Procedures, available online and at the ECC, explain the details of ECC functionality and operation, including available technologies such as radio and satellite telephone communications.

The ECC is equipped with a hard copy of key / critical BC Hydro plans to assist response and recovery efforts. All documentation can also be found via Emergency Management share point site.

Event response information is to be stored here: Emergency Event Response

Emergency Management (EM) is responsible for the establishment and maintenance of the ECC, including all resources, equipment availability and functionality, which are tested every 3 months.

Section 3. ACTIVATING THE EMERGENCY COORDINATION CENTRE

3.01 Activating the ECC – high severity or escalating event

Figure 4 shows the ECC activation procedure.

Initial Response Staff do not auto-deploy for high severity or escalating events.

An initial ECC coordination call may be convened by Emergency Management or the Duty Coordinator in response to:

1. Request by a Director, General Manager, Vice President, or delegate
2. Escalated reports to the Duty Coordinator requesting support for an imminent high severity risk or an occurring high severity incident
3. Threshold criteria have been met (refer to section 2.01 and list of considerations below)

Upon notification of a high severity emergency (or imminent threat) situation, the business unit and/or operational management lead(s) most impacted by the emergency will be contacted and consulted on:

- the need to activate the ECC
- potential role assignments
- ECC activation level, including virtual or physical reporting

During discussions, the “go / no go” decision will be made on ECC activation and initial role assignments, including that of ECC Director.

Some considerations of when to activate the ECC include, but not limited to the following:

- Significant system outage with potential for safety or reputational risk
- More than one line of business impacted
- Requirement for cross business group coordination
- Significant logistic or resource requirements
- Significant information management requirements
- Current or imminent:
  - High severity security or safety impacts
  - Significant economic, societal and/or environmental impacts
  - Significant financial implications
  - Limitations on staff availability
  - Damage to one or more major BC Hydro facilities or assets
  - Need to relocate critical business functions
  - Provincial declaration of a state of emergency

The list of ECC Director / Deputy Directors is in Appendix B.

There are three (3) levels of ECC activation:

Level 1 - Oversight and monitoring – often virtual
Level 2 - Partial Activation – often virtural with a few roles occupied in the ECC

Level 3 - Full Activation – all key roles occupied in the ECC where possible

Virtual participation is planned for in all cases and depends on the status of technologies and communication tools as well as the circumstances and availability of staff and facilities. The ECC Director and Manager determine the degree of virtual participation.

Upon activation the Director and Manager will:

- Determine initial ECC staffing level
- Initiate/confirm ECC staff and roles
- Obtain and confirm information on the situation
- Set initial priorities, objectives and key activities
- Set ECC deliverables and schedule of activities for next 24 hours
- Initiate/continue ECC reporting and documentation

Refer to Emergency Centre Activation Guideline for more details.

Role of the Duty Coordinator when ECC is activated

When the ECC is activated the Duty Coordinator plays a supportive role and remains 'on-duty' to support other emergencies or situations across the company, reporting to the ECC Director and Manager to ensure effective communications to the Executive Team. The ECC Director through consultation with the Duty Coordinator provides the overall company status as a single point of contact.

The on call Duty Coordinator may have an ECC assigned role, and will look to other Duty Coordinators to cover as necessary.

3.02 Activating the ECC – large scale or catastrophic event

Following a large scale event that does not allow for an orderly situation assessment and opening of the Emergency Coordination Centre, the steps in the Initial Response Action Table (page 3-4) will be taken. The ECC will be opened by default via these steps.

Figure 4 shows the ECC activation procedure.

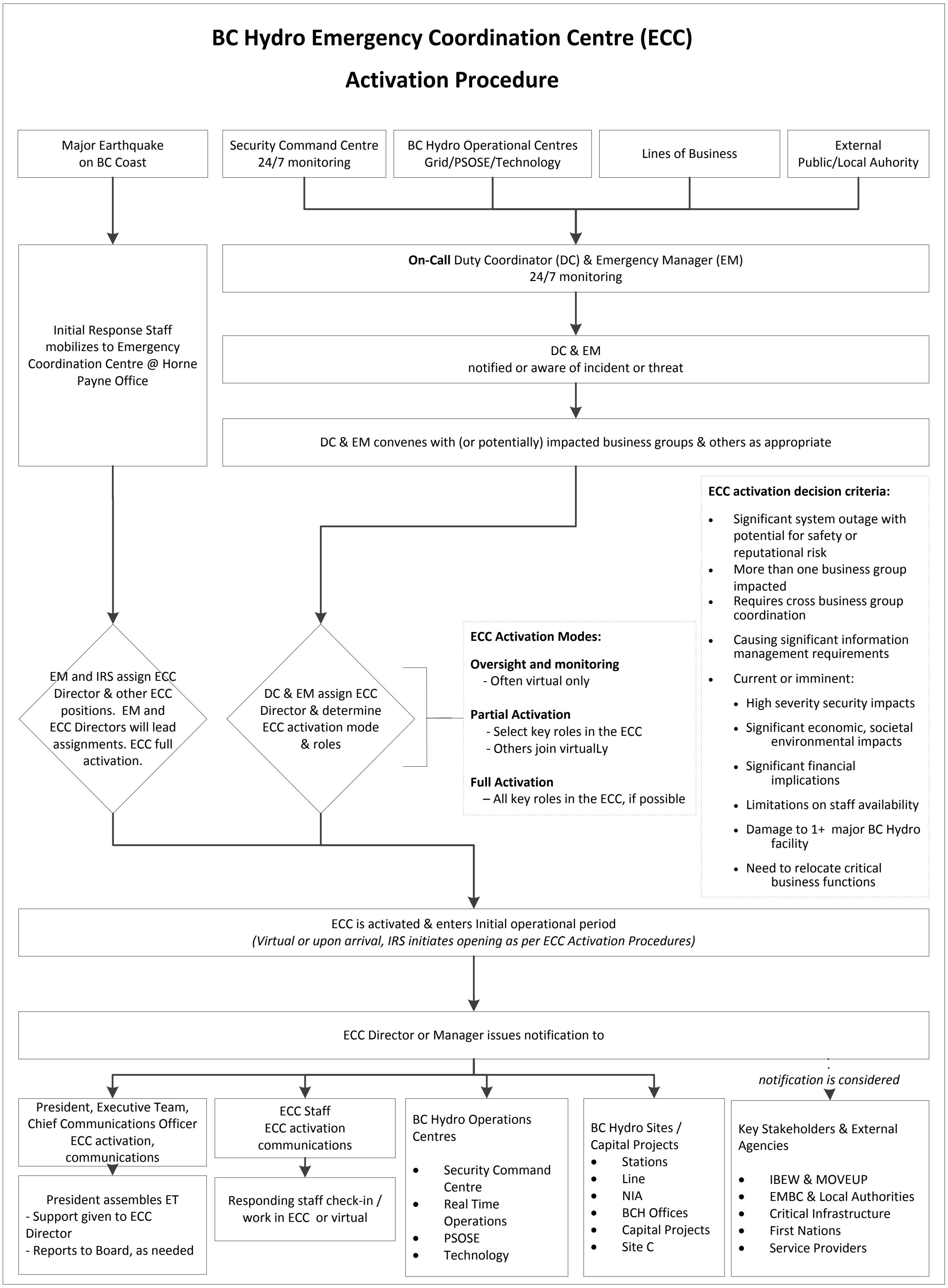


Figure 4: Emergency Coordination Centre Activation Flowchart

Section 4. STAFF ROLES & RESPONSIBILITIES

The ECC has two categories of staff listed below and further explained in Sections 4.01 and 4.02.

1. Initial Response Staff (IRS)
2. Emergency Coordination Centre Staff

The complete list of IRS and ECC Staff can be found in Appendix A and B. It should be noted that:

- One person may support more than one function and may be called-out or reassigned to a different role by the ECC Director.
- More than 1 person is identified for each role in order to provide "depth" for initial call-out. Additional individuals can/will be called out depending on the emergency.
- Resources across the province may be called upon to support ECC operations.

4.01 Initial Response Staff (IRS)

Initial Response Staff (IRS) are those BC Hydro employees who, after a major emergency (i.e. major earthquake on BC coast) self-deploy to the primary ECC at the Horne Payne Office. The Senior Emergency Manager will lead the IRS in assigning roles amongst themselves. Upon deployment (i.e. after an earthquake) the IRS will need to confirm with the Horne Payne Incident Command Team a building damage assessment has been completed and the facility is safe to occupy.

- During business hours, the Horne Payne Incident Command Team will self-deploy.
- During non-business hours, the Security Command Centre staff (24x7) may initiate this until the arrival of of assigned Rapid Building Damage Assessors.

As IRS members deploy to the ECC, they are to reply to BC Hydro alerts and attempt to connect using this phone bridge at the top of every **even** hour following an emergency (i.e. 4:00, 6:00, 8:00, etc.) until sufficient contact has been made and roles / status confirmed.

Primary IRS Conference Bridge

Dial in	**1-877-708-3350**
Access code	**3529033#**

There is a hyperlink to all other ECC conference bridges in Appendix C.

In the event that telecommunication services are impacted, other communication options available to make / attempt contact in addition to Send Word Now include:

- Email
- Text messages (smart and cell phones)
- Other messenger or communication system (i.e. Office Communicator)
- Satellite telephone
- Tetra radio

4.02 ECC Staff

The roles and responsibilities defined below are mainly applicable over the first days of the emergency and activities may gradually evolve over the emergency response period, depending on the duration and outcome of the event. The description of responsibilities is general and may need adjusting based on the particular incident.

The roles and responsibilities listed are specific to emergency management, aimed at coordination of activities. **It is expected that the majority of decisions, while coordinated by the ECC, will continue to be made by individuals following their roles and responsibilities under normal operations.**

Table 2 outlines the roles and responsibilities of the President, Executive Team, Chief Communications Officer and Emergency Coordination Centre Staff.

Refer to Section 7 (ECC Position Checklists) for descriptions of roles identified in the ECC Organization Chart (Section 2.06, figure 3). As our emergency program matures, role descriptions are added and revised.

ROLE	RESPONSIBILITY
PRESIDENT	• Chair the Executive Team emergency response • Keep Board informed during the event • Liaise with Executive & BC Hydro ECC Director to collect current & most accurate situational information
EXECUTIVE TEAM	• Participate in Executive Team / ECC briefings • Provide policy guidance to BC Hydro Emergency Coordination Centre (BCH ECC) • Provide approval for access to external agency support & extraordinary financial expenditures • Be BC Hydro spokesperson, conduct media briefings • Provide approval to address unusual external requests made to BCH for support
DIRECTOR & DEPUTY DIRECTOR	• Direct & manage BC Hydro's overall response & restoration activities • Liaise with & provide regular situation updates to the Executive Team & President • Ensure adequate resourcing for response & restoration activities • Ensure liaison with external agencies • Conduct media briefings or assign public communications prime • Maintain situation awareness & approve all key documents/information
MANAGER	• Reports to the ECC Director • Sets up the ECC upon activation • Ensures that ECC is fully functional at all times • Provides subject matter expertise and advises on emergency management • Coordinates appropriate level of documentation of ECC operations
SAFETY LEAD	• Reports to the ECC Director • Monitors ongoing health and well-being of ECC staff • Provides subject matter expertise for ECC's decisions and action • Provides oversight on all safety related issues with regards to the incident • Interprets safety regulations and liaises with safety investigators
LEGAL SERVICES	• Reports to the ECC Director • Monitors potential or ongoing legal issues • Provides subject matter expertise for ECC's decisions and action related to legal matters

	• Provides oversight on all legal related issues with regards to the incident
OPERATIONS LEAD / SECTION - 24 hour horizon	• Reports to the ECC Director • Communicates with Site Incident Commanders, Grid Operations and PSOSE, REOC Emergency Centre Directors, and Site Incident Commanders • Continuously assesses developing situation and coordinates response action for next 24 hours • Provides situation information to Section as basis for plans beyond 24 hours • Coordinates information flow between field, PSOSE, Grid Operations and ECC
PLANNING LEAD / SECTION - beyond 24 hour horizon	• Reports to the ECC Director • Works with Operations and Logistics Leads to identify and prioritize emergency actions beyond next day horizon through to the end of the emergency situation • Develops a model of the situation: How bad is it, what is the extent of damage, what are the implications, how do we need to respond, do we need more information? Prepares situation reports • Develop overall picture and provides information to the Communications/Information & Liaison Lead for communications • Managers data and documentation (drawings, manuals, operating orders, incoming/outgoing technical documentation, storage etc.)
LOGISTICS LEAD / SECTION	• Reports to the ECC Director • Ensures that personnel, material, facilities, business systems and service requests are addressed • Resolves any competing resource demand or shortage issues. Manages contracts process in order to procure contractors, equipment, consultants and materials • Ensures functionality of technology, communications and IT infrastructure • Coordinates security issue
FINANCE / ADMINISTRATION LEAD / SECTION	• Reports to the ECC Director • Identifies and manages administrative support to all ECC • Provides financial tracking, reporting and analysis • Works with Logistics Section to minimize delays in acquisition of resources and associated payments • Obtains and delegates appropriate financial authority limits and establishes emergency financial processes • Prepares ECC staffing and shift schedules • Ensures availability of emergency funding
COMMUNICATIONS (INFORMATION & LIAISON LEAD) / SECTION	• Reports to the ECC Director • Seeks and collects situation information from all Sections and external sources, consolidates issues and develops messages • Supports ECC staff / event response in all communication needs • Communicates with public, employees, government, agencies, First Nations, and stakeholders

Table 2 – ECC Management and Lead Roles and Responsibilities

Section 5. PLAN OWNERSHIP & REQUIREMENTS

5.01 Plan Ownership, Administration, Training & Exercising

This Plan is owned by the President, with support from Emergency Management (EM). The Plan will be reviewed annually on or before **December 31** every two years, with the exception of Role Assignments and Contacts which may be updated as changes are known. The responsibility for updating the Plan, including all Appendices, is delegated by the President to the Manager, EM.

The EM Program Administrator is responsible for receiving and incorporating updated contact information and staff changes, including aligning and maintaining relevant information in Send Word Now.

EM and business units are jointly responsible for developing training materials and initial and follow-up (every 3 years) training of staff for role assignments in the ECC and for corporate-wide exercises (every 5 years). Actual event experience may count as practical training.

Section 6. APPENDICES

COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 2

T&D Asset Management Framework

British Columbia Hydro and Power Authority

Transmission and Distribution

Asset Management Framework

DECEMBER 2016 • Version 4

BC Hydro
Power smart

BC Hydro
Transmission & Distribution
Asset Investment Management
6911 Southpoint Drive
Burnaby, B.C., V3N 4X8

Approved for Issue	Ajay Kumar, Vice-President, T&D Asset Investment Management
Date	Dec 16, 2016

Responsible Personnel:

Name	Group	Position Title
Larry Haffner	T&D, Asset Sustain	Manager, Asset Investment Management; Asset Sustain Manager
Joyce Arthur	Consultant, Duncan Kent & Associates Ltd.	Senior Technical Writer

Table of Contents

List of Figures and Tables

Important Links

Asset Investment Management Hydroweb page http://hw/our_bus/td/a_i_m/Pages/default.aspx

Asset Sustainment Hydroweb page: http://hw/our_bus/td/a_i_m/ams/Pages/default.aspx

Asset Investment Management SharePoint: http://hydroshare/sites/pas55/default.aspx

1.0 Introduction

1.1 Purpose and Scope

The Asset Management Framework (AMF) defines the integrated structure of BC Hydro's asset management system for transmission and distribution assets. It sets out the basis for planning and managing these assets across the system, including an overview of BC Hydro processes.

The overall objective of the AMF is to implement a performance-based culture at BC Hydro by achieving effective performance awareness and accountability and improved metrics and targets. Another key objective is to increase customer satisfaction through improved service levels, such as by ensuring that customers have a single point of contact and web-enabled self-serve options.

The Asset Investment Management (AIM) group is part of BC Hydro's Transmission & Distribution (T&D) division. AIM is responsible for planning, operating, and maintaining BC Hydro's T&D assets through implementation of the AMF.

The scope of the AMF involves developing policies and strategies to meet performance objectives of the organization and the physical infrastructure assets. Specific actions include:

- Long-term integrated planning
- Risk management
- Portfolio and program development
- Performance evaluation
- Structured decision-making processes

The AMF pulls together key policies, plans, objectives, and strategies related to asset management. This document defines those elements (see page 16) and shows how they are linked together in a hierarchy (see Figure 3).

Implementation and management of the AMF has been proceeding successfully since 2012 and is an ongoing process. Revisions and adjustments are made to the AMF as required to ensure efficiency and sustainability over time. Periodic audits help to refine the AMF, and training of T&D staff around the AMF is also ongoing.

1.2 T&D Assets Covered by AMF

The AMF focuses primarily on the management of physical infrastructure assets and related asset systems, including but not limited to:

- Transmission circuits
- Distribution circuits
- Rights-of-way
- Substations
- Telecommunication facilities
- Vegetation management program (T&D)
- Non-integrated areas (NIA)
- Third party service agreements (co-owners of assets)
- Revenue meters
- Customer connections / Interconnections (including shared assets)

1.3 About This Document

This document describes the Asset Management Framework used by BC Hydro's T&D Asset Investment Management Group (T&D AIM) to govern and manage the physical assets that make up the T&D system. It details the approved policies, strategies, objectives, plans, and standards required to plan and manage these assets across the system.

The AMF summarizes or references both new and existing processes and supporting documents. This is a living document that represents the AMF as BC Hydro is currently implementing it.

T&D AIM created this document and is responsible for reviewing and maintaining it as required. Document approval is granted by Larry Haffner, Manager, Asset Investment Management. If you have questions about this document, contact Larry Haffner: larry.haffner@bchydro.com; 604-516-8840.

Every year, the Asset Management program is reviewed in conjunction with the AMF. The goal is to verify and demonstrate that the AM program is functioning as per the Framework, and to identify any gaps or shortcomings so improvements can be made to the program This year's finalized checklist noting findings and issues can be found here.

1.4 Updating the Framework Document

This procedure will be followed to update the *T&D Asset Management Framework*:

1. Anyone who has a change or update to suggest should email it to larry.haffner@bchydro.com. This should optimally be done **during Q2**, but changes are accepted at any time of the year.
2. Changes submitted will be periodically reviewed over the year and if approved, added to a working draft of the revised document (but not published).
3. The deadline for changes to be submitted for review and possible inclusion in the next published version is **September 30** each year.
4. During **Q3 (fall)**, all changes gathered and approved in the previous four quarters will be included.
5. Asset Managers will also meet in Q3 to review and update the Framework document with any new or changed information.
6. After final approval, the draft will be finalized and re-published in **November** each year.
7. A **Change Log** at the back of the document will reflect the date of each change, section number and title, person responsible, and a description of the change.

2.0 Asset Management Framework

2.1 Objectives

The key objectives of the Asset Management Framework are to:

- Ensure strategic alignment between the corporate mission, vision, strategies, and plans with the day-to-day activities of managing the T&D assets.
- Provide the foundation for best practices across the T&D AIM organization.
- Help fulfill BC Hydro's mandate of sustainable, effective, and efficient delivery of services to customers, which depends on the sustained function and performance of its physical assets.
- Provide measurable assurance to BC Hydro's shareholder (the Government of B.C.), regulator (BCUC), First Nations, and stakeholders that physical assets are being managed prudently and in compliance with all applicable regulatory requirements and standards for reliability, safety, and the environment.
- Support BC Hydro's mandate of continuous improvement through a prudent management approach where investments target the best value-for-money decisions, minimize the total life cycle cost of asset ownership, improve corporate reputation, and enhance shareholder value.

2.2 Principles

2.2.1 Framework Principles

To be successful, the AMF relies on these essential asset management principles:

- An integrated organizational structure with clear direction and leadership that facilitates the implementation of approved policy and strategy, according to the attributes in Figure 1
- Clarity of control, accountability, and reporting requirements for assets that are fully defined and clearly established, communicated, and implemented across the organization
- Integrated management, planning, investment, and reporting that consider all elements of the operational and business environment as per Figure 3
- Structured risk-based decision-making that considers the total cost of asset ownership along with documentation of economic and technical evaluations of alternatives
- Timely, accessible, and accurate information and knowledge of asset condition, technology, performance, risks and costs, and the interrelationship between these

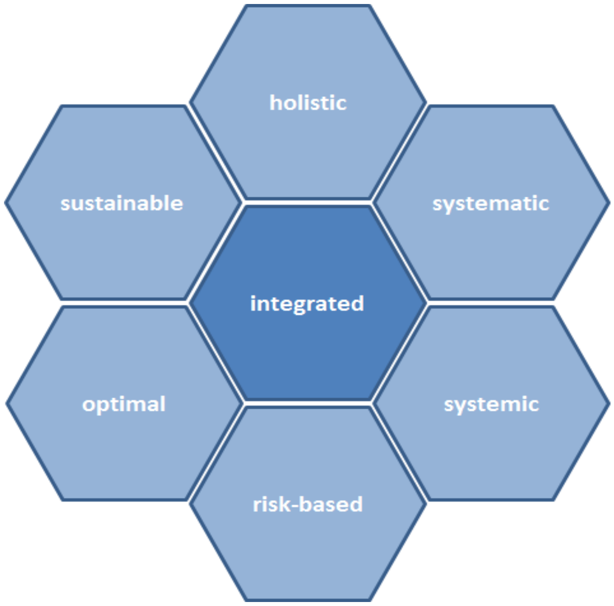


Figure 1: Key Principles of Asset Management

(Source: PAS 55-1:2008, pg v)

2.2.2 T&D Life Cycle Asset Management Principles

BC Hydro manages its assets through the effective and efficient application of life cycle asset management principles and practices. Life cycle asset management is a business model designed to maximize economic return on physical assets over their life by achieving desired performance outcomes, while efficiently managing the risks inherent in owning, managing, and operating a large asset base. The fundamental principle behind the asset management approach is “making the right decision at the right time”, maximizing the asset value while minimizing risk, and achieving corporate priorities.

Life cycle management is a strategic approach to decision-making throughout an asset’s lifetime, including asset acquisition/creation, operation and maintenance, life extension and refurbishment programs, and decommissioning and disposal.

The following nine principles guide life cycle asset management within BC Hydro T&D:

Identification of Asset Safety Hazards in T&D System: Articulate safety hazards associated with T&D assets, provide timely communication to affected staff, and implement mitigation plans where feasible. Examples of hazards include bushings with PCB, assets with asbestos, and confined spaces. AIM provides information and a centralized inventory of all these hazards in the Safehub database: http://hw/our_bus/bchs/ms/Pages/safehub.aspx.

Value Maximization: Achieve targeted performance and manage risk at acceptable levels while at the same time maximizing the value of all assets over their life by optimizing total Operations and Maintenance (O&M) expenditures plus capital investments. Overall, the impact of total life cycle cost for an asset is considered crucial in determining capital expenditure levels. Risks and performance are assessed in many dimensions including safety, reliability, revenue, cost, and environmental and social performance.

Figure 2: Value Maximization Principle

Knowledge-Based Decisions: Ensure availability of good data that translates into knowledge to optimize decision-making, set priorities, and allocate resources. BC Hydro T&D collects data on the operation, performance, and condition of its transmission assets as well as updated equipment specifications and costs, maintenance records etc. to incorporate into strategy development, prioritization, and other decision-making processes.

Decision Transparency: Maintain confidence and public support with a transparent and well-documented decision framework, using decision support tools such as the Optimizer/Prioritization tools and multi-factor analysis. As a Crown corporation, BC Hydro is subject to significant scrutiny from the public, its regulators, and the Government of B.C.

Asset Wide Standards and Procedures: Develop and adhere to clear standards as a critical way to maintain the quality and integrity of the T&D system. BC Hydro has developed standards for the design, engineering, acquisition, operation, maintenance, and disposal of its transmission and distribution assets.

Asset Performance Measures: Ensure that performance measures are true and enduring in order to track trends in performance over time, since changes in asset performance occur slowly.

Functional Asset Plans: Document the long-term strategy for each asset class, taking into account the asset's role, condition, performance targets, risks, and growth opportunities, as well as strategies for each stage of the asset's life cycle.

Continuous Improvement: Measure, review, and report (e.g., failures, non-conformities) on asset performance and automate processes where possible. Review functional asset plans regularly as part of the T&D capital and maintenance planning process, and update them based on new information, compliance and performance monitoring, and continuous improvement of processes and practices.

Practices: Implement leading practices in T&D design, operation, and asset management; and participate in the development of standards and practices internationally in order to contribute to BC Hydro's reputation as a world-class company and leader in T&D asset management. BC Hydro participates in international technical organizations such as the International Association for Electrical and Electronic Engineers (IEEE), International Council on Large Electric Systems (CIGRE), and other professional organizations that provide an important source of information and professional development.

2.3 Meeting the PAS 55 Specification

To ensure effective management of T&D assets, the AMF is consistent with current practice among leading utilities, BC Hydro's own unique situation, the 2008 PAS 55 industry specification on asset management, and ISO 55000:2014, a general standard for asset management. BC Hydro T&D was an active supporter of the development of the PAS 55 Standard for Asset Management.

PAS 55 describes asset management as the "systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan."

Note: Compliance with the PAS 55 does not confer immunity from legal obligations.

2.4 Structure of Asset Management Framework

The Asset Management Framework diagram in Figure 3 shows the links between the T&D asset management system (including physical assets, asset policies, strategies, and objectives), and BC Hydro's corporate mission, vision, values, priorities, and 5-year plan. These are the high-level elements required to deliver an effective system based on defined asset objectives. Performance monitoring and continuous improvement are an integral part of the AMF. It also incorporates the influences of the external stakeholder environment and internal environment of other groups across the corporation.

T&D has established asset management policies, strategies, objectives, and plans, including effective control mechanisms and compliance monitoring for all of its transmission and distribution assets. Specifically:

- High-level asset management policies are derived from and consistent with BC Hydro's corporate strategic plan, as well as the corporate vision and mission. The policies provide the framework in which the asset management strategy, objectives, and plans can be produced and implemented.
- Asset management strategies are derived from and consistent with the asset management policies.
- Asset management objectives are derived from and consistent with asset management strategies, and with BC Hydro's commitment to continual improvement.
- Asset investment plans and functional asset plans are linked to the asset management objectives that they are intended to achieve, and drive the detailed asset class strategies specific to each asset type.

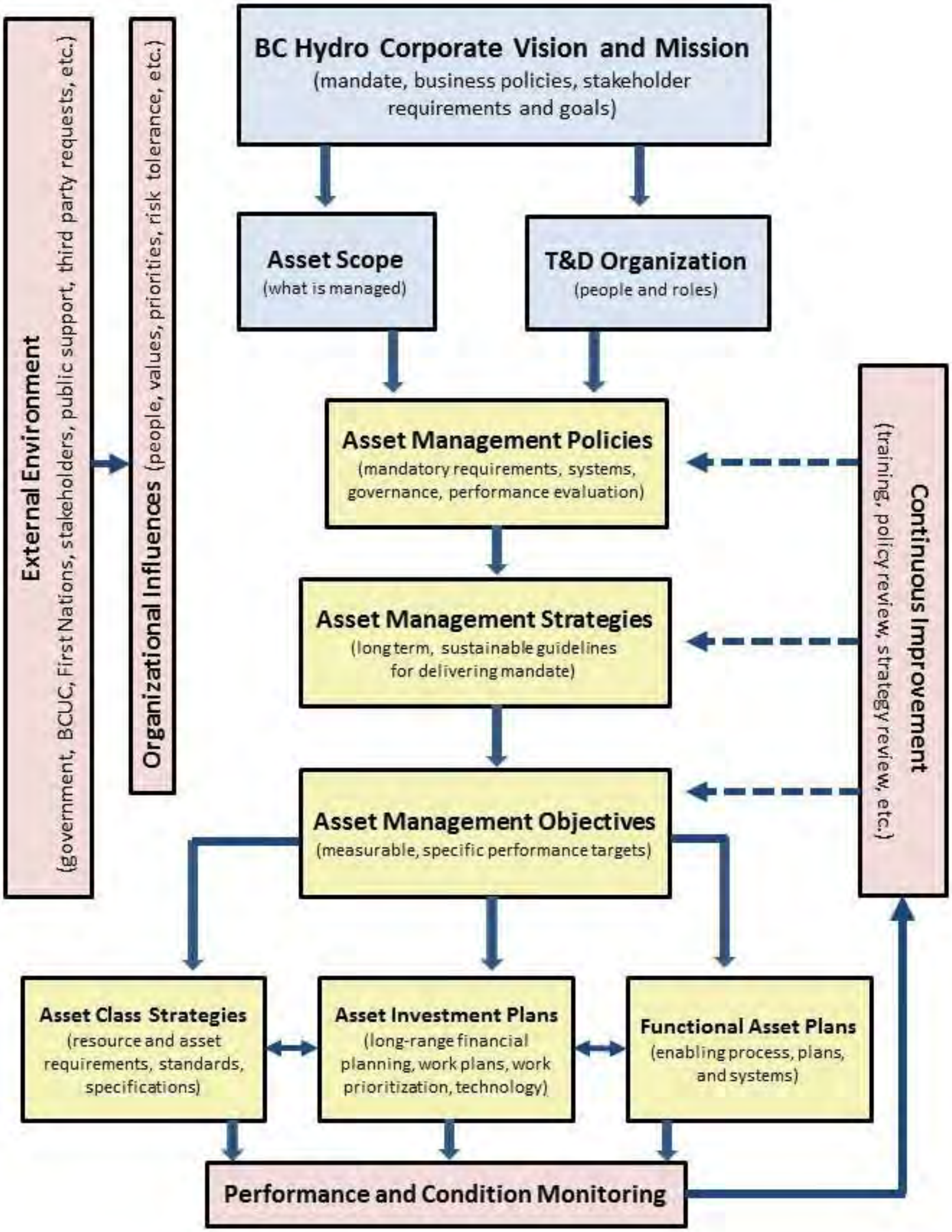


Figure 3: BC Hydro Asset Management Framework

As shown in Figure 4, corporate organizational management is out of scope for the AMF.

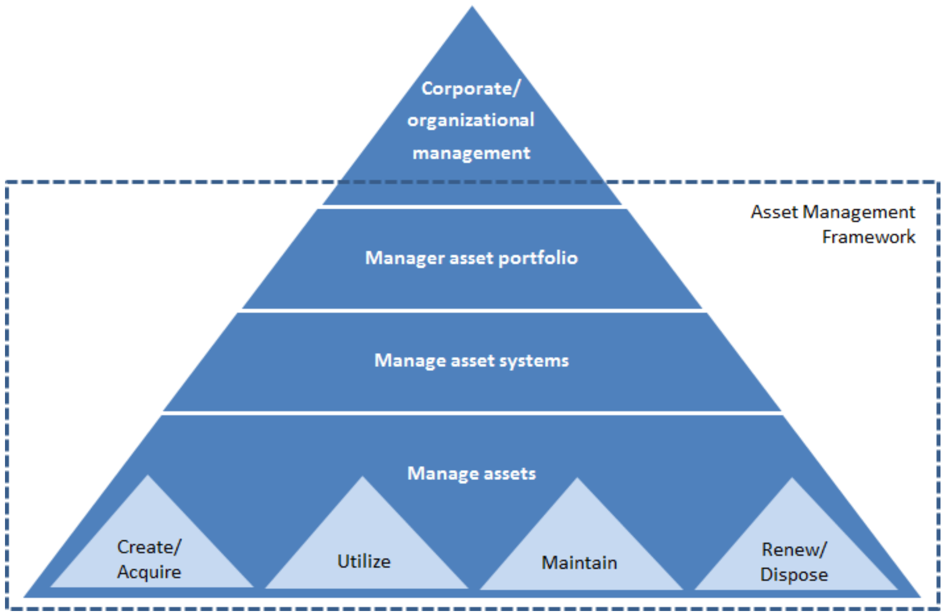


Figure 4: Levels of Assets and Management Relative to the AMF

(Source: PAS 55-1:2008, pg vii)

2.5 Physical versus Other Assets

In addition to physical assets, BC Hydro manages four other categories of assets to achieve organizational plans and business objectives (see Figure 5):

- Personnel and contractors
- Information
- Financial assets
- Intangible assets (reputation, morale, intellectual property, goodwill, and so on)

The management of physical assets is inextricably linked to the management of these other asset types, which are critical to the successful achievement of sustainable asset management and require due consideration. However, the AMF only considers these assets where there is a direct impact on the optimal management of the physical assets. This is especially pertinent for operational efficiency, which is directly related to the performance of BC Hydro's management and staff, contractors, and suppliers.

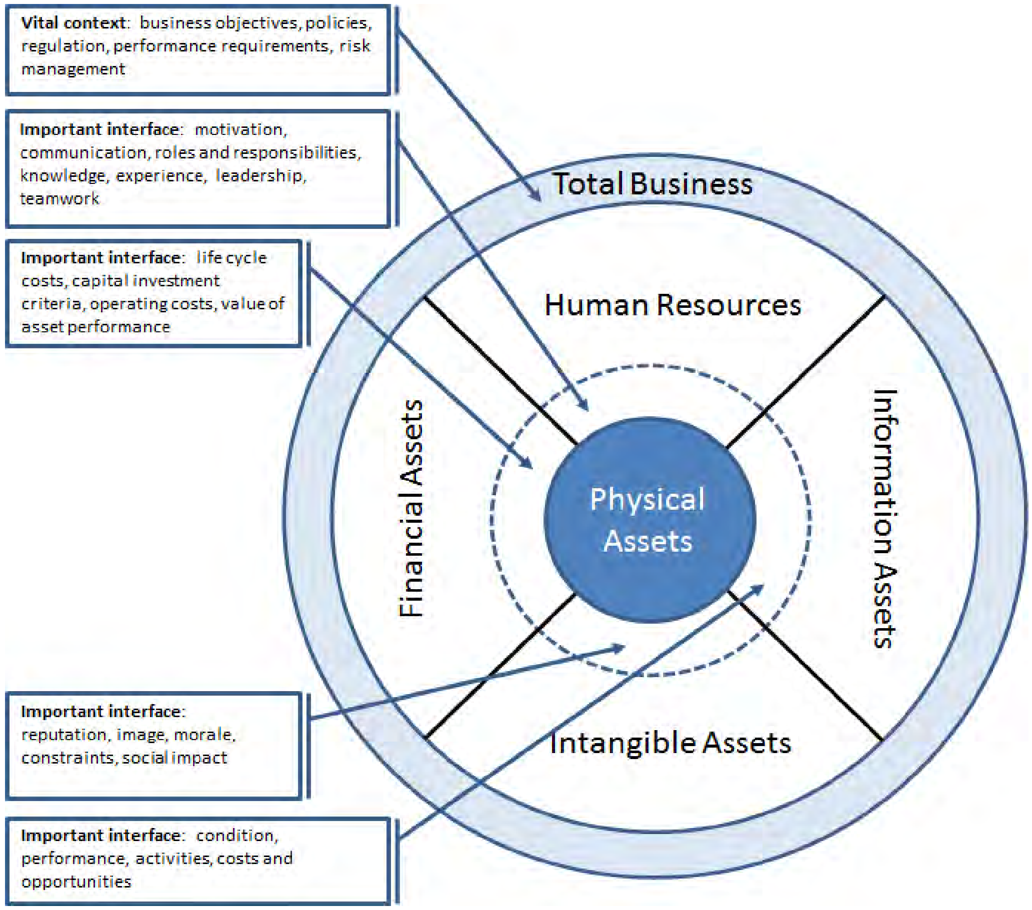


Figure 5: Business Context of Physical Assets in Relation to Other Categories of Assets

(Source: PAS 55-1:2008, pg vi)

2.6 Asset Optimization

BC Hydro's physical infrastructure assets represent more than the sum of their components or the services they deliver. Assets are capital intensive to build or replace and are essential for economic development in the province.

As assets age, evolving strategies for ensuring continued effective operations and reliability of service become central. Asset managers responsible for physical assets need to make efficient and effective decisions about relevant capital or operational investments in an environment of finite human resources and capital. Value is created for the company through the strategic management of existing assets and the acquisition of new assets as required.

BC Hydro optimizes the return on all investments by:

- Ensuring systematic processes are in place to manage assets effectively over the long-term
- Adopting the appropriate functional and mandatory reliability standards
- Complying with the relevant legal, regulatory, and statutory requirements

2.7 Definitions

Figure 3 on page 13 shows the hierarchy and links between the following key concepts and tools for the Asset Management Framework. To help provide a basic understanding of the terms as well as show how they interrelate and function together in the framework, both generic definitions and ones specific to the framework are provided. In some cases, the same word may have different meanings depending on which level of the framework it applies to, such as “asset management **policy**” and “functional **policy**.”

2.7.1 Framework

Framework	A broad overview or outline of interlinked items that supports a particular approach to a specific objective, and serves as a guide or model.
Asset Management Framework	Defines the integrated structure of BC Hydro’s asset management system for transmission and distribution assets, and sets out the basis for planning and managing these assets across the system.
Asset Management Framework Document	This document, also referred to as the “framework document” or AMF.

2.7.2 Asset

Asset	An individual plant, machinery, equipment, property, building, structure, vehicle, server, software application, or other related system with an assessable business value or function for the operation of the T&D system.
Asset Class	A particular category of BC Hydro assets, such as circuit breakers, wood poles, or power line systems.
Asset Life Cycle	The entire service life of an asset, beginning with identifying the need for that asset and ending with disposal by decommissioning, retirement, or sale of the asset. The main stages include design, acquisition/construction, operation, maintenance, and renewal or disposal.
Asset Life Cycle Management	A strategic business model designed to maximize economic return on physical assets over their life cycle by achieving desired performance outcomes, while efficiently managing the risks inherent in owning, managing, and operating a large asset base.
Asset Maintenance	The PAS 55-1:2008 defines Asset Maintenance as: “Maintenance includes inspection, condition monitoring, functional testing, repair, refurbishment, and/or life extension of assets. Replacement of individual assets may also be considered as maintenance of asset systems.”
Asset Management System	A system used to establish policy, strategy, and objectives related to asset management, and to achieve those objectives though the implementation of plans. BC Hydro’s asset management system consists of asset management policies, strategies, objectives, and plans, and all of the activities and structures necessary for their development, implementation, and continual improvement.

Asset System	A grouping of assets that interact as a composite whole or are interrelated to deliver a required business function, such as a transmission circuit with its power lines and tower structures.

2.7.3 Policy

Policy	A documented set of broad guidelines and principles that is formulated and enforced by the governing body of an organization. A policy determines how strategies are devised and implemented, and directs the plans, decisions, and actions of employees towards achieving the organization's long-term priorities and plans.
Asset Management Policy	A principle or requirement that is derived from or consistent with BC Hydro's corporate strategic plan, and which provides a framework for the development and implementation of the asset management strategy and the setting for asset management objectives. An asset management policy is cross-functional, considering the life cycle optimization of all relevant activities related to asset management. BC Hydro's overall Asset Management Policy is to plan, develop, and maintain a safe, reliable, and efficient T&D system that sustainably serves the needs of our customers and meets the policy objectives of our shareholder.
Functional Policy	A specified approach or rule for the control of specific asset-related processes and activities. For example, a functional policy may relate to capital investment, construction methods, purchase of a particular asset, or life cycle maintenance.

2.7.4 Strategy

Strategy	A method or plan designed to achieve a desired outcome, such as reaching a goal or solving a problem. Strategizing is the art and science of planning and marshalling resources for their most efficient and effective use.
Asset Management Strategy	A long-term optimized approach to management of the assets, which is derived from and consistent with the corporate strategic plan and the asset management policy. This strategy converts the objectives of BC Hydro's strategic plan and the asset management policy into a high-level, long-term action plan for the assets, asset systems, and asset management system. An asset management strategy is focused on asset health, performance, financial, and risk objectives.
Asset Class Strategy	A strategy specific to a particular asset or asset class, such as a strategy for managing transformers in a substation over their life cycle. A strategy may cover a specific make and model of transformer, or a component of the transformer. The strategy takes into account resource and other requirements for the asset, as well as standards and specifications for the asset.

2.7.5 Priority / Objective

Priority	Priorities are strategic objectives that are given top billing in terms of their importance to an organization. BC Hydro has six key priorities that support and direct all business operations: • Make it easy for customers to do business with us. • Deliver capital projects on time and on budget. • Explore the full potential of energy conservation. • Strengthen our proud and valued workforce. • Continue to improve the way we operate.
Objective	An end that can be reasonably achieved within an expected timeframe and with available resources. Objectives are basic tools that underlie all planning and strategic activities, and serve as the basis for policy. In general, an objective is broader in scope than a goal and may consist of several individual goals.
Asset Management Objective	A specific and measurable outcome or achievement required to implement an asset management policy or strategy, or the asset management system itself. Overall asset management objectives include: financial accountability, reliability, safety, and operational effectiveness. Specific asset management objectives are tied to a particular asset or an asset class or system, such as a detailed and measurable level of performance required of an asset.

2.7.6 Plan

Plan	A written account of an intended future course of action aimed at achieving a specific goal or objective within a specific timeframe. A plan explains in detail what needs to be done, when, how, and by whom. The planning process identifies the goals or objectives to be achieved, formulates strategies to achieve them, arranges or creates the means required, and implements and monitors all steps.
Asset Investment Plan	A document specifying activities, resources, responsibilities, and timescales for implementing the asset management strategy and delivering asset management objectives.
Functional Asset Plan	A plan specific to an asset or asset class that enables the implementation of asset management processes, plans, and systems.
Capital Plan (T&D)	The long-term centralized planning budget for new and replacement equipment, systems, substations, T&D circuits, supporting infrastructure, or other major capital expenditures.
O&M Plan (T&D)	The Operations and Maintenance Plan that contains individual facility or asset class budgets required to sustain the current system or assets over a 3-year period.

2.7.7 Performance

Asset Performance Management	A management methodology to maintain reliable asset performance – it defines recurring activities to establish organizational goals, monitor progress toward the goals, and make adjustments to achieve those goals more effectively and efficiently.
Benchmarking	A systematic and continuous measurement process that identifies major performance improvement opportunities by comparing key results and work activities with industry peers or similar industries. Benchmarking supplies a quality target to shoot for (e.g., for a performance indicator such as reliability, safety, time, or cost), with the aim of achieving and sustaining best-in-class performance by making improvements and closing gaps.
Condition Assessment	A detailed inspection of an asset to identify defects and hidden failures; determine the severity of defects, rate of degradation, identify corrective actions; and evaluate the overall health of the asset and its ability to continue performing for the remainder of its expected life.
Performance Metric	A measure of how well an asset performs compared to a pre-set performance standard or specification in terms of reliability, accuracy, cost, or other performance targets.
Performance Standard	A set of criteria for determining if an asset is functioning as intended. While some criteria are absolute and easily discovered (such as a transformer fault causing an outage), others rely on reliability analysis, risk assessments, and engineering judgment to establish thresholds for acceptable performance. Performance standards are generally defined on the basis of asset maintenance classes.

2.7.8 Other Definitions

Procedure	A specified way of carrying out an activity or a process, generally a step-by-step sequence of activities that must be followed in the same order to correctly perform a task.
Process	A sequence of interrelated or interacting procedures that transforms inputs into outputs. Processes can be operational or management-related.
Standard	A generally accepted requirement followed by members of an industry, or a written procedure or requirement that is approved and monitored for compliance by BC Hydro or a regulatory agency as a minimum acceptable benchmark.
Specification	A detailed statement of particular requirements that must be satisfied by an asset, material, service, or system, or a precise description of an item's technical characteristics.

3.0 BC Hydro's Organizational and Regulatory Requirements

The Asset Management Framework is consistent with BC Hydro's corporate vision, mission, objectives, and values, as well as its corporate policies and goals. More information is available in BC Hydro's most recent Annual Service Plan Report (2015/16).

3.1 BC Hydro's Mission, Vision, Values, and Priorities

In September 2015, BC Hydro unveiled a new 5-year plan for the future. With a changing environment, we have to evolve to meet new demands: growing customer expectations, delivering on our large capital programs, energy conservation goals, and modernizing our technology. At the same time, we need to find more ways to keep rates low for our customers. We have to constantly work smarter, think smarter, and plan for the future.

Our existing Service Plan continues to be our accountability framework for annual reporting to our Shareholder and customers. This Plan outlines key strategies, metrics, and results we expect to achieve over the next three years, as well as our financial forecast. The new 5-year plan outlines our five company-wide priorities for the next few years, in areas where we need to make some different and significant gains. By focusing on them, they will in turn impact every aspect of our organization for the better.

The 5-year plan, and BC Hydro's new mission, vision, values, and priorities, are described in detail in the report: *Smart about power in all we do: Our plan to guide our work* (September 2015).

3.1.1 Mission

Our mission is to provide our customers with reliable, affordable, clean electricity throughout B.C., safely.

3.1.2 Vision

Our vision is to be the most trusted, innovative utility company in North America by being smart about power in all we do.

This vision gives us something to work towards, and provides the context for our business decisions.

3.1.3 Values

We have six core values that guide us:

- We are safe.
- We are here for our customers.
- We are one team.
- We act with integrity.
- We respect our province.
- We are forward-thinking.

3.1.4 Priorities

These are our five company-wide priorities:

1. Make it easy for customers to do business with us.
2. Deliver capital projects on time and on budget.
3. Explore the full potential of energy conservation.
4. Strengthen our proud and valued workforce.
5. Continue to improve the way we operate.

1.  2.  3.  4.  5. 

3.2 BC Hydro's Asset Management Policy

BC Hydro's asset management policy governs the framework and our strategies.

BC Hydro
Power smart

Asset Management Policy - T&D Assets

BC Hydro's corporate mission is "**To provide reliable, affordable, clean electricity throughout BC, safely**". To support this corporate vision, T&D's mandate is "**As a dynamic T&D team, we safely and efficiently deliver reliable power to our communities of today and tomorrow**". To achieve our corporate mission and deliver on T&D's mandate:

> **Our asset management policy is to plan, develop and maintain a safe, reliable and efficient T&D system that sustainably serves the needs of our customers and meets the policy objectives of our shareholder. We will not compromise the safety of BC Hydro employees, customers and the public. We shall comply with all legal, regulatory and environmental requirements.**

To deliver on the asset management policy, we will rely on the expertise of our people and the following key principles and mandated requirements:

- Maintain and evolve an **Asset Management Framework** that is consistent with leading industry practices like Publically Available Specification (PAS) 55;
- Make decisions based on the complete **lifecycle of our assets** to develop investment plans (capital and OMA) that are sustainable, innovative, efficient and optimised based on cost, risk (including safety) and performance;
- Ensure that our investment plans meet all applicable **standards** (e.g. BCUC approved Mandatory Reliability Standards, regulations and any related corporate policies);
- Meet our commitments to **customers, First Nations, stakeholders, interconnected utilities and partners**;
- Provide the technical and business services required to effectively interconnect customers;
- Utilize an **investment prioritization and risk management framework** that meets BC Hydro's corporate objectives to develop our investment plans;
- Develop and operationalize **resource strategies** that allow for effective planning and execution of investment plans;
- Consult **across BC Hydro** for the efficient planning and execution of our investment plans;
- Monitor appropriate **performance metrics** to measure the performance of our assets;
- Undergo formal **management reviews** and **audits** to continually improve our asset management practices; and
- Develop and maintain **asset information** for managing the assets across all the life cycle phases effectively.

Signed:	Signed:
Ajay Kumar Vice-President, AIM Transmission & Distribution BC Hydro	Greg Reimer Executive Vice-President Transmission & Distribution BC Hydro

December 5, 2016

3.3 Provincial Energy Policy

T&D AIM's policies conform with the objectives of the 2010 *Clean Energy Act*, the 2007 BC Energy Plan, as well as subsequent and future revisions to the Energy Plan.

3.3.1 2010 Clean Energy Act

The 2010 *Clean Energy Act* consolidated BC Hydro and BC Transmission Corporation into a single entity to more effectively plan and deliver the clean energy required to meet B.C.'s growing demand for electricity.

In addition to the energy self-sufficiency targets set in 2007, the 2010 *Clean Energy Act* sets objectives related to greenhouse gas targets, economic development and jobs creation, and the need to foster development of First Nations and rural communities by using and developing clean or renewable resources. It also sets a goal for B.C. to be a "net exporter of electricity from clean and renewable resources."

The *Clean Energy Act* identifies 16 objectives. Of those, 5 are directly applicable to the planning, construction, operation, and maintenance of the T&D system:

- **Objective C**: To generate 93% of the electricity in British Columbia from clean or renewable energy resources and to build the infrastructure necessary to transmit that electricity.
- **Objective D**: To use and foster the development in B.C. of innovative technologies that support energy conservation and efficiency and the use of clean or renewable resources.
- **Objective F**: To ensure that the authorities' rates remain among the most competitive of rates charged by public utilities in North America.
- **Objective G**: To reduce B.C. greenhouse gas emissions.
- **Objective M**: To maximize the value, including the incremental value of the resources that are clean or renewable, of B.C.'s generation and transmission assets for the benefit of British Columbia.

In 2012, the *Clean Energy Act* was amended to redefine self-sufficiency, as recommended by the B.C. Government's 2011 review of BC Hydro. The amendment eliminates the requirement for BC Hydro to acquire an extra 3,000 gigawatt hours per year of insurance by 2020. The change ensures that customers continue to benefit from economical electricity rates.

BC Hydro is required to produce an Integrated Resource Plan under the *Clean Energy Act*, (here is the 2013 plan) which must include:

- A description of what BC Hydro plans to do to achieve energy self-sufficiency and to respond to B.C.'s other energy objectives, including plans for the construction or extension of facilities
- A description of the export market potential, the extent to which BC Hydro has arranged contracts for the export of electricity, and the transmission or other services necessary to facilitate those exports
- A description of BC Hydro's infrastructure and capacity needs for the electricity transmission system for the period ending 30 years after the Integrated Resource Plan is submitted

Finally, the *Clean Energy Act* provides clear direction regarding the use of Burrard Thermal Generating Station under Part 2 – Prohibitions. Section 13 states that BC Hydro must not operate the Burrard Thermal plant, except:

- In case of an emergency
- To provide transmission support services
- As authorized by regulation

3.3.2 2007 BC Energy Plan

The 2007 BC Energy Plan, *A Vision for Clean Energy Leadership*, rose out of the 2002 document *Energy for Our Future: A Plan for BC.* The plan puts forward the government's vision and blueprint for the province's energy future. It provides guidance to BC Hydro on how it should meet the future energy needs of British Columbians, given today's challenges of a growing energy demand, higher prices, climate change, and the need for environmental sustainability.

The BC Energy Plan strengthens B.C.'s environmental leadership through the following key policy actions (relevant to BC Hydro):

- Zero greenhouse gas emissions from coal-fired electricity generation
- All new electricity generation projects to have zero net greenhouse gas emissions
- Zero net greenhouse gas emissions from existing thermal generation power plants by 2016
- Clean or renewable electricity generation to account for at least 90% of total generation

The BC Energy Plan sets ambitious conservation targets to reduce the growth in electricity usage. One such target is to acquire 50% of BC Hydro's incremental resource needs through conservation by 2020. Achieving this target would see electricity use per household decline to about 9,000 Kwh per year by 2020.

To ensure B.C.'s energy security, the BC Energy Plan sets the following key policy actions (relevant to BC Hydro):

- Maintain public ownership of BC Hydro.
- Maintain our competitive electricity rate advantage.
- Achieve electricity self-sufficiency by 2016.
- Make small power part of the solution through a set purchase price for electricity generated from projects up to 10 megawatts.

To support future innovation and to help bridge the gap in bringing innovations through the pre-commercial stage to market, the B.C. government will:

- Establish an Innovative Clean Energy Fund of $25 million.
- Implement the B.C. Bioenergy Strategy to take full advantage of B.C.'s abundant sources of renewable energy.
- Generate electricity from mountain pine beetle wood by turning wood waste into energy.

3.4 BC Hydro's Shareholder

BC Hydro's shareholder is the Government of B.C. As a provincial Crown corporation, BC Hydro receives guidance from the Government of B.C. through several policy instruments, including a Shareholder's Letter of Expectations, the 2002 and 2007 Energy Plans, and the 2010 *Clean Energy Act*. The government's expectations are expressed in three essential ways, through legislation, policy, and instructions:

Legislation:

- BC Hydro is governed by and derives its mandate from the *Hydro and Power Authority Act*.
- The *Utilities Commission Act* gives the British Columbia Utilities Commission (BCUC) the power to regulate BC Hydro (see below under *Regulators*).
- BC Hydro's assets come under the terms of the *BC Hydro Public Power Legacy and Heritage Contract Act,* which ensures public ownership of BC Hydro's transmission and distribution systems.
- BC Hydro plays a key role in fulfilling the objectives of the 2010 *Clean Energy Act* (see page 24).

Policy: The BC Energy Plan provides guidance to BC Hydro on how it should meet the future energy needs of British Columbians (see page 25).

Instructions: The Shareholder's Letter of Expectations describes the relationships between BC Hydro and the Government of B.C., and sets out objectives that the Government of B.C. wishes BC Hydro to achieve. Directions outlined in the letter focus on accountability, energy conservation, climate change, stakeholders, and First Nations. The Government of B.C. reviews the letter annually with BC Hydro and updates it as required.

3.5 Regulators

3.5.1 BC Utilities Commission

BC Hydro is regulated by the British Columbia Utilities Commission (BCUC), which is responsible for protecting the public interest under the Utilities Commission Act by ensuring that:

- Customers receive safe, reliable, and non-discriminatory energy services at fair rates from the utilities it regulates.
- Shareholders of utilities have a reasonable opportunity to earn a fair return on their invested capital.
- The competitive interests of B.C. businesses are not frustrated.

BC Hydro follows BCUC requirements that regulate the domestic supply of electricity and rates; the safety and reliability of the electrical system; and operating, management, and administrative costs.

The work of T&D AIM may be affected by BCUC decisions on BC Hydro's revenue requirements and its general approach to asset management.

3.5.2 Tariffs

BC Hydro's services and rates are set out in tariffs (pricing schedules), as mandated by the BCUC:

Open Access Transmission Tariff: Sets out the terms and conditions by which BC Hydro conducts business with customers, with rate schedules that outline the prices for transmission services.

Electric Tariff: Contains the approved terms and conditions of distribution voltage service provided by BC Hydro, as well as the approved rates for service at distribution voltage and transmission voltage. Additional terms and conditions of transmission voltage service are contained in Tariff Supplements 5 and 6.

3.5.3 NERC and WECC

In 2009, the BCUC adopted the North American Electric Reliability Corporation (NERC) and the Western Electricity Coordinating Council (WECC) mandatory reliability standards (MRS) as required and enforceable in B.C. MRS is a comprehensive package of standards for the planning, operation, and maintenance of the North American electricity grid.

NERC's Compliance Monitoring and Enforcement Program (CMEP) comprises three key activities:

- Compliance monitoring: Measuring compliance with NERC standards
- Compliance enforcement: Issuing sanctions and ensuring mitigation of confirmed violations of mandatory NERC reliability standards, such as remedial action directives or mitigation plans

- Due process: Providing registrants with the opportunity to contest any finding of a violation of a NERC reliability standard, including hearings and appeals

WECC monitors, assesses, and enforces compliance with NERC's CMEP and Mandatory Reliability Standards, as well as WECC's Regional Reliability Standards, by all bulk-power system owners, operators, and users in the Western Interconnection.

3.5.4 Measurement Canada

BC Hydro adheres to the mandatory requirements of Measurement Canada, which is BC Hydro's federal regulator. MC ensures the integrity and accuracy of measurement in the Canadian marketplace. For BC Hydro, this relates mostly to the accuracy of revenue meters.

Revenue Metering Systems Management (RMSM) manages a well-established Revenue Metering Quality Management System according to MC requirements. Measurement Canada conducts an annual surveillance audit of this system, focusing primarily on the activities and records located at the Meter Shop and Main Distribution Centre.

3.5.5 National Energy Board

The National Energy Board (NEB) is an independent federal agency established in 1959 by the Parliament of Canada to regulate international and interprovincial aspects of the oil, gas, and electric utility industries. The purpose of the NEB is to regulate pipelines, energy development, and trade in the Canadian public interest. Among other things, the NEB regulates the export of electricity to other provinces and countries.

3.6 BC Hydro Corporate Policies

T&D AIM ensures that its asset management practices follow BC Hydro corporate policies. The policies most relevant to T&D asset management include:

Customer Service Policy (Intranet site): BC Hydro maximizes value to customers and shareholders by taking responsibility for our actions; being fair and honest, open and straightforward; seeking solutions and building relationships; and working together to achieve results.

Environmental Policy (public site): BC Hydro commits to producing, acquiring, delivering, and consuming electricity in an environmentally, socially, and financially responsible manner.

Financial Policy and Control (Intranet site): The Board of Directors and Executive members of BC Hydro are responsible and accountable for the financial integrity of the corporation and all business groups and subsidiaries. The *Management and Accounting Policies and Procedures* (MAPP) manual details BC Hydro's policies for accounting and financial management. It includes policies, procedures, guidelines, and controls for financial and selected other corporate policies.

General Procurement Policy (Intranet site): BC Hydro commits to applying sound procurement practices to support the objective of procuring materials and services that represent the highest overall value to BC Hydro; to foster a competitive, fair, open and transparent procurement environment; and to comply with applicable law, including regulatory requirements and directives.

Records and Information Management Policy (Intranet site): BC Hydro commits to providing efficient and effective information systems to help employees achieve corporate priorities and ensure information availability. BC Hydro employs records management practices and controls that enable it to meet legal, regulatory, and business requirements. (T&D has identified requirements for information and records management, and embedded controls in the business processes to achieve the requirements. T&D works with the OCIO to establish supporting technology. Information is made accessible to employees and stakeholders as appropriate.)

Risk Management Policy (Intranet site): BC Hydro commits to diligently managing risks according to provisions of appropriate externally recognized standards. BC Hydro establishes practical and economic risk evaluation criteria, control mechanisms, and tolerable risk levels.

Safety Policy (public site): BC Hydro commits to integrating safety in all we do. We conduct our operations to minimize the chance of injury to employees, contractors, and the public. We work for continual improvement in safety performance, driving to our vision of zero injuries.

Social Responsibility Policy (public site): BC Hydro commits to producing, acquiring, delivering, and consuming electricity in an environmentally, socially, and financially responsible manner. Social responsibility depends on developing and fostering healthy relationships with employees, customers, First Nations communities, and stakeholders.

4.0 T&D Mandate, Organization, and Operations

BC Hydro's Transmission & Distribution (T&D) division is responsible for planning, constructing, operating, maintaining, renewing, and disposing of the company's transmission and distribution assets. This section describes the T&D vision, mission, mandate, and operating model. It also outlines the specific roles of T&D AIM (Asset Investment Management), the group responsible for managing T&D asset investments.

4.1 T&D Vision and Mission

Vision: We are recognized as a leading integrated T&D asset management department, delivering safe, cost-effective, innovative, sustainable, and reliable total life cycle management for the transmission and distribution system, while synergizing effectively with other BC Hydro groups involved with asset management.

Mission: We strategically define Capital Sustain and Maintenance programs for T&D assets, using risk management, asset strategies and standards, and quality management to enable the long-term, safe, reliable, efficient, and environmentally-sensitive operation of the transmission and distribution system.

4.1.1 T&D Mandate

As a dynamic T&D Team, we safely and efficiently deliver reliable power to our communities of today and tomorrow.

4.1.2 T&D Objectives

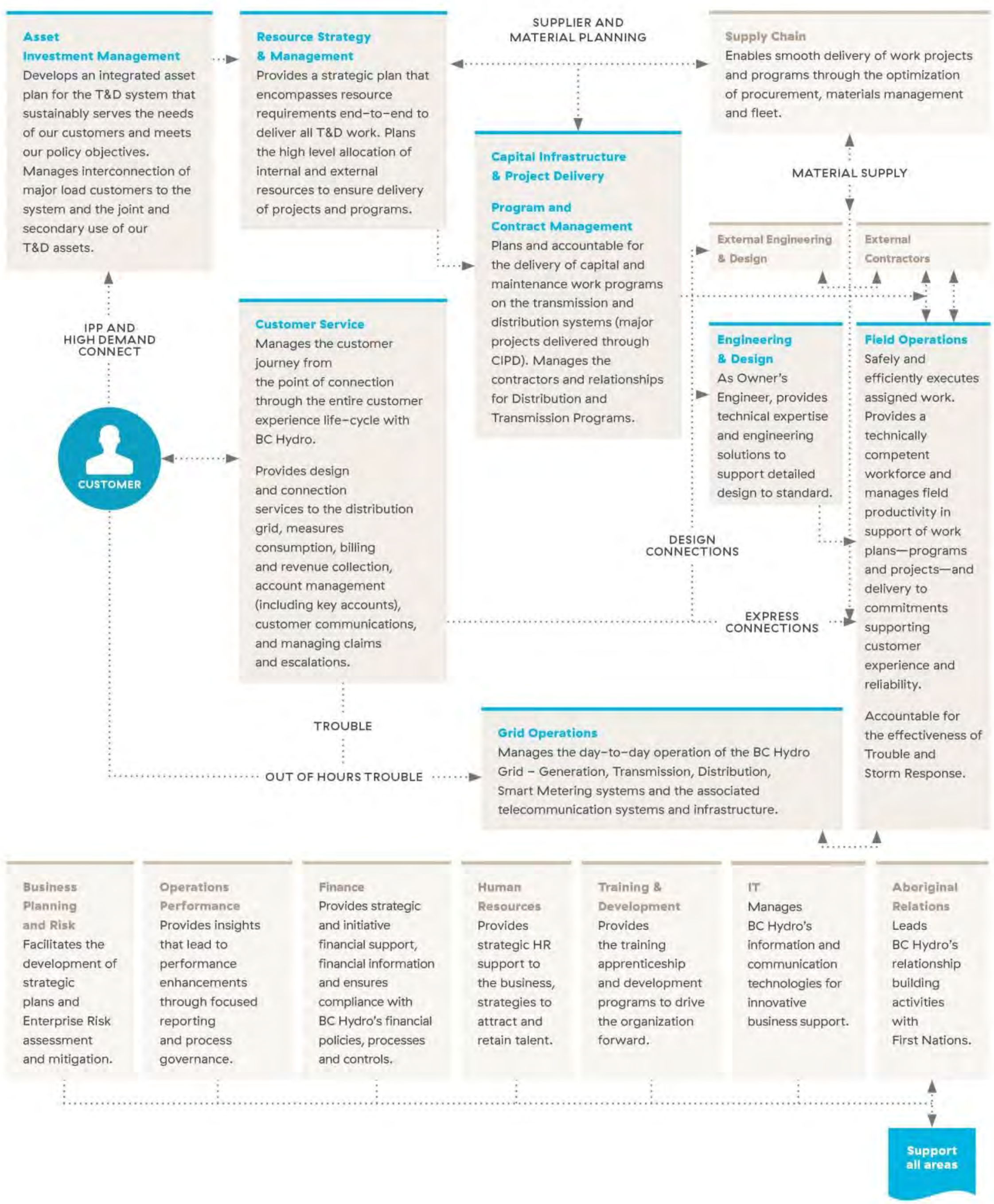
The T&D core business is to safely plan, design, build, operate and maintain the power delivery system across the province. The strategy is comprised of core objectives that support this core business and identify key focus areas to successfully accomplish our work and reach our goals.

- **Safety**: Everyone demands and contributes to an environment that ensures their own safety, and the safety of others.
- **Reliability**: We effectively plan, design, build, operate, and maintain the power delivery system to meet the changing electricity needs of our customers.
- **Operational Excellence**: We align people, processes, and technology to deliver on the T&D mandate in an efficient and effective way.
- **Innovation and Technology**: We create business value by being outward looking, resourceful and, innovative in our work and application of technology.
- **Enduring Relationships**: Succeeding by building trusted relationships with customers, First Nations, and stakeholders.
- **High Performing and Sustainable Workforce**: We attract, retain, and continually develop a diverse team of highly engaged employees who are accountable for results.

4.2 T&D Operating Model

The Operating Model in Figure 6 depicts T&D's high-level work flow and associated accountabilities across various groups. The work flow spans all T&D processes from governance to planning to execution to maintenance. T&D maintains an effective and efficient organizational structure, with defined competency requirements for roles that are aligned with development and training plans. The department uses a mechanism for sourcing of needs and work with Resource Strategy & Management (RSM) and Human Resources.

Figure 6: T&D Operating Model



4.3 Overall Roles of BC Hydro Functional Areas

Tables 1, 2, and 3 describes the overall roles of various functional areas within BC Hydro that play a role in implementing the AMF, including AIM, other groups in T&D, and BC Hydro corporate offices/groups that play some role in asset management. The third column in Tables 2 and 3 indicates coordination points between those groups and T&D AIM.

Organizational charts for all groups in T&D can be found here: http://hw/our_bus/td/pages/orgcharts.aspx.

4.3.1 Asset Investment Management

Table 1: AIM Functional Areas and Overall Roles

Functional Area	Roles
***Asset Investment Management* (T&D AIM)**	
Ajay Kumar (acting)	Manages the transmission and distribution system and assets, including for example: o Develops integrated asset management plan for the T&D system in collaboration with various stakeholders. o Develops asset management policies, principles, strategies, and standards for the asset. o Identifies asset programs to support expansion and maintenance needs. o Manages project prioritization and risk management processes. o Creates and maintains the multi-year (>10 year) investment plan. o Makes informed decisions regarding asset investments and carries out value scenarios. o Sponsors and monitors capital projects. o Engages in NERC/WECC governance and operational activities. • Undertakes activities associated with the interconnection of existing and future generation and major load customers to the integrated BC Hydro system. • Manages the joint-use (TELUS) agreement and secondary use of the T&D assets. • Oversees and manages BC Hydro's Mandatory Reliability Standards (MRS) Program. • Facilitates fair and open access to BC Hydro's transmission grid, through administration of the Open Access Transmission Tariff (OATT) and operation of the wholesale transmission market.
AIM Groups:	
Asset Investment Optimization (AIO) Ginette Handfield	• Leads the development and ongoing management of optimized capital investments for the transmission and distribution system assets, taking into account financial and human resource constraints, in alignment with BC Hydro and T&D strategic direction. • Continually enhances the asset investment optimization framework, methodology, and process for T&D, and, jointly with the other BC Hydro Business Groups, for capital prioritization at the Corporate level.
Asset Sustainment Larry Haffner	• Directs systematic and coordinated activities and practices to optimally manage T&D assets and asset systems. • Manages T&D assets through the application of life cycle asset management principles and practices. • Monitors associated performance, risks, and expenditures over their life cycles for the purpose of achieving our priorities and the 5-year plan. *Sub-groups:* **Lines Strategy & Standards**: (Jim Papadoulis) • Manages the assets installed on both the Transmission Lines and the Distribution Lines outside of Substations. • Undertakes programs and projects that cover the inspection, maintenance, repair, and end-of-life replacement of overhead and underground assets.

Functional Area	Roles
	• Defines programs and sets budget requirements for yearly work plans and long-term investments. • Guides asset strategies for emergency restoration projects. • Develops and implements long-term strategies for each asset class, as well as asset maintenance policy and standards. • Manages the risks of asset failure, maximizes asset life, and maintains reliability and customer satisfaction at minimal cost while keeping rates stable for our ratepayers. • Defines asset and material needs for growth, sustainment, and emergency work • Collaborates with Growth Capital Planning and Capital Infrastructure & Project Delivery on growth projects to ensure that long-term sustainment needs for new assets are met. **Protection Control (P&C) and Telecom Strategy and Standards**: (Dave Bains) Accountable for asset management oversight of all Protection, Control, SCADA, and Telecommunications assets located in substations and microwave sites around the province. The group takes leadership and responsibility for: • Compliance with all applicable regulatory (NERC / WECC) compliance standards. • Managing risk to prioritize and balance the sustainment needs of the system against available resources. • Creating asset maintenance strategies and standards. • Defining, planning, and ensuring delivery of Preventive Maintenance Programs. • Planning and executing all stations P&C / Telecom sustain capital projects. • Providing planning services for P&C / Telecom and Stations design groups. • Supporting analysis of power system disturbances. • Conducting contingency planning and interacting with external agencies and utilities to ensure BC Hydro planning requirements are met. • Offering services to meet the needs of T&D and Generation, including technical support and training, software/tools development, power system disturbance analysis, reliability tracking, and more. **Rights of Way & Roads**: (Mike Guité) • Responsible for sustainment of rights-of-way and access issues for the T&D System. • Initiates sustaining capital investments for these assets, including investments to roads and helipads, and managing deficient rights. • Acts as AIM Lead for Powergrid GIS and sustainment of geomatics (including initiating LiDAR and photogrammetric surveys). **Stations Strategy & Standards**: (Ed Burt) • Responsible for sustainment of transmission, step-down, and telecom stations on the BC Hydro grid, including Capital sustainment and enhancement planning, operations and maintenance planning, stations design standards and policies, stations maintenance standards and policies, and spare equipment management. **Vegetation Strategy & Standards**: (Tom Wells) • Ensures public and worker safety and system reliability on Transmission ROWs and Distribution corridors. • Responsible for defining and funding the Vegetation Management Programs. • Ensures quality assurance and efficacy of the program and methodologies employed. • Writes vegetation standards to ensure that all work conforms to current industry accepted practices.
Distribution Engineering & Standards Jorg Stangl	• Develops and publishes Distribution Standards and Specifications for the design and construction of the BC Hydro distribution system. • Engineers major distribution system projects to improve system performance and provide safe reliable interconnection to BC Hydro distribution connected customers (load and generators). • Acts as the owner's engineer for externally-engineered and project-managed major distribution system projects to ensure consistent delivery of work. • Provides expert technical services to internal partners for the safe reliable operation of the distribution system, including protection coordination evaluations, voltage and power

Functional Area	Roles
	quality investigations, and power outage reviews and recommendations. • Delivers a variety of distribution system data and records management services, including drafting services for projects, GIS record updates, drafting operate drawings, and producing standards drawings. • Delivers Distribution Estimating process and procedures for internal stakeholders to produce high-quality accurate costs for distribution projects, including maintaining the compatible unit estimating system. *Sub-groups:* • **Distribution Engineering**: (Samira Verjee) Accountable for project engineering for internally delivered projects; owner's engineering oversight for externally delivered projects; operational engineering support to our Field and Design organizations; drafting and drawing management for all drawings required for the Distribution system and substations, and Transmission one-line drawings for the Transmission system. • **Distribution Standards**: (Fred Dennert) Delivers comprehensive construction standards, specifications for design and construction, product approvals, and design standards to ensure effective application of equipment. Conduct investigations into customer complaints on power quality concerns. • **Distribution Estimating**: (Hamid Gharachamani) Works to improve and maintain the tools and procedures used for work estimating across BC Hydro's Distribution business. Undertakes detailed review of large cost estimates, as well as investigates significant actual-to-estimate variances to identify improvements. • **T&D Reliability**: (Devinder Ghangass) Investigates significant reliability events on the T&D system and recommends solutions or future improvements.
Distribution Planning & Reliability Altaf Hussain	• Manages the reliability and integrity of the distribution system. • Evaluates the distribution system and develops strategies and plans for the system to accommodate short- and long-term growth, and distributed energy resource interconnections. • Engages in strategic planning to set planning criteria and strategies, distribution area planning with a long-term focus (4-10 years), feeder planning with a mid-term focus (1-3 years), and conducting interconnection studies for distributed energy resources. • Plans for the supply, testing, and maintenance of BC Hydro's revenue meters in compliance with Measurement Canada's revenue metering requirements. • Supports AIM with business and asset performance monitoring by providing business and reliability performance analysis and reporting, asset condition assessments and corresponding data management, and facilitating reliability benchmarking studies and surveys. *Sub-groups:* • **Distribution Area Planning**: (Milan Prpic) Performs system and interconnection studies; develops short- and long-term system plans to ensure adequate system capacity, system reliability, and system performance; develops and issues distribution system load forecasts; and ensures Distributed Generation (DG) facilities are interconnected to the BC Hydro system in a safe, reliable, and efficient manner. • **Distribution Automation & Strategic Planning**: (Cheong Siew) Develops strategies, guidelines, and practices for distribution system that align with corporate objectives and facilitate required distribution system performance. Ensures that technological advancement in system and equipment monitoring, control, and automation are incorporated into strategic and reliability planning and that impact of customer technologies (e.g., electrical vehicles) are appropriately considered.. • **Distribution Feeder Planning:** (Thomas Mah) Manages and supports planning level functions, including feeder analysis and studies and development of mid-term (1-3 years) system improvement plans that affect the capacity, reliability, and overall performance of the distribution system feeders and associated equipment. Ensures prudent risk and capital investment balance through development of capital projects and justifications, securing funding approvals, and coordination with the delivery organization for project execution. • **Reliability & Asset Performance Assessment:** (Thomas Ta) Provides performance

Functional Area	Roles
	analysis and reporting in compliance with BC Hydro's business applications. Supports internal business functions and external stakeholders such as regulatory and benchmarking agencies to facilitate policies and reliability improvement initiatives within T&D. Supports transmission and distribution asset and work management by managing asset information and implementing maintenance standards and preventive maintenance programs. • **Revenue Metering Systems Management:** (James Fan, acting) Provides and manages BC Hydro's metering assets for both T&D by ensuring the application of Metering Standards and Guides, as developed in compliance with Measurement Canada's *Electricity and Gas Inspection Act and Regulations*, in order to safeguard interests of BC Hydro and its customers including Independent Power Producers. Services provided include revenue metering engineering and products, quality assurance programs, record maintenance for meters and metering equipment, and customer support.
Interconnections and Shared Assets (I&SA) Frank Lin	• Manages customer requests to interconnect, supply, or receive electrical services from the T&D system. Types of interconnection requests include generators, transmission loads, and major distribution loads (defined as loads with greater than 5 MVA and/or $1 million in interconnection costs). Activities include managing interconnection tariffs; developing and applying interconnection policies; and managing interconnection queues, processes, and agreements. • Manages initial and ongoing customer life cycle relationships and commitments while ensuring compliance with all tariff requirements, interconnection agreement obligations, and system technical needs. • Manages third-party requests to relocate BC Hydro T&D infrastructure. • Manages the joint ownership and use agreement with TELUS (co-owner of 80% of distribution poles) and third party co-location requests. This includes activities such as establishing contractual agreements, managing agreements and billings, conducting contract compliance reviews, and working with other groups within BC Hydro to deliver on contractual obligations and resolve issues that arise. I&SA also ensures that operation of the BC Hydro system is not compromised by the co-location of third party assets. *Sub-groups:* • **Customer Interconnections & Policy**: (Sam Jones) Oversees requests from load customers. Includes the following departments: Transmission Load Interconnections, Major Distribution Load Interconnections, Distribution Design Policy, and Distribution Process. • **Generator Interconnections**: (Ryan Hefflick) Oversees requests from generator owners or independent power producers (IPP) to get connected to the BC Hydro grid. Includes Transmission Generator Interconnections and Distribution Generator Interconnections. . • **Joint Use & Shared Assets:** (Brian Tabe) Joint Use administers the BC Hydro/TELUS business relationship and financial transactions under the 1971 Joint Use Agreement; sets out and implements appropriate processes and commercial arrangements. Shared Assets acts as the single point of contact for requests for the attachment of third party equipment to BC Hydro overhead or underground T&D infrastructure.
Transmission & Stations Planning Prem Chand	• Plans the growth capital expenditures associated with the transmission and substation distribution assets • Conducts operational planning required for ensuring a safe and reliable power system. • Carries out all technical planning required for interconnecting new industrial loads and generation to the transmission system. • Undertakes Point-to-Point studies related to transmission service on the system. *Sub-groups:* • **Growth Capital Planning:** (Wah Shum) Plans capital investments required to reinforce and expand the transmission system to meet growth in load, to integrate new generation resources, and to accommodate transmission customer projects. Typically leads the long-range area planning, which involves input from stations, distribution, and sustain in an integrated manner. • **Performance Planning**: (Guihua Wang) Provides support to Grid Operations (GO) for asset upgrades and additions by developing/updating system operating orders, system

Functional Area	Roles
	operating limits (SOL), and application tools to help optimize system performance. Conducts major system disturbance analysis and special operational planning studies. Manages transmission system performance to its maximum use by identifying/developing special protection schemes (RAS) and its application. Manages inter-tie issues with neighbor utilities. Fulfills obligations of WECC on generator modelling and PEAK/NWPP path SOL studies. • **Power System Modelling & Analysis**: (Tito Inga-Rojas) Manages and delivers power system models for performing engineering studies to support all transmission planning processes in T&D. This includes growth capital planning, interconnection planning, performance planning, network integration transmission services, and NERC TPL annual assessment. The group is also responsible for supporting the technology infrastructure (application tools, databases, etc.) used by the staff in the Transmission & Station Planning group. • **Stations Planning**: (Prem Chand) Plans activities for all substations, including expansion and upgrades of existing stations and additions of new stations to accommodate load growth. Completes plans for different loads and Independent Power Producers (IPPs), as well as interconnections. Provides financially sound annual capital planning for existing station expansion/upgrades and new station additions for all load growth projects. Interacts intensively with a range of BC Hydro groups to complete effective planning. Stations Planning has three *Sub-groups:* System, Equipment, and Analytical Studies.

4.3.2 Other T&D Groups

Table 2: Other T&D Groups: Functional Areas and Overall Roles

Functional Area	Roles	Coordination with AIM / Asset Management Role
Distribution Design and Customer Connections		
Charlotte Mitha	Distribution Design and Customer Connections supports the electrical connection of BC Hydro's customers and provides design and technical services for other Distribution System work programs, including system improvement, maintenance, and end-of-life asset replacement projects. The customer connection work includes the planning, design, and project coordination for complex connections to BC Hydro's distribution system; responding to over 35,000 customer requests each year for simple new service connections, upgrades, and service disconnects; and supporting customers and developers in the design and construction of underground residential distribution electrical infrastructure through BC Hydro-approved professional electrical engineering firms. These functions are performed by Design staff located in facilities throughout the province, as well as in centralized Express Connect operations centres. *Sub-groups:* • Customer Program Office (Ned Dharamshi) • Distribution Design (Ingo Moxon) • Express Connect (Kees Jansen) • Distribution Technical Services (Kevin McInnes)	• Develops annual plan for Customer Work for next fiscal year. • Works with PCM to determine allocation of design work plan between internal Design and external service providers. • Delivers all distribution design work to standards and provides QA/QC for externally designed work. • Coordinates budgeting, administration, and approvals with PCM and AIM for all non-customer Design work. • Provides monthly reports to AIM and PCM on program progress. • Supports implementation of T&D Operating Model.

Functional Area	Roles	Coordination with AIM / Asset Management Role
***Field & Grid Operations* (FGO)**		
David Lebeter	Responsible for the day-to-day safe operation, restoration, and maintenance of the entire T&D system. Manages the safe, efficient, and reliable operation of the generation, transmission, distribution, and telecom systems, and the delivery of electricity in B.C. *Sub-groups*: (more details below) • Construction Services • Real Time Operations • Regional Operations • Smart Technology Operations & Restoration (STOR) • Trouble Operations Support	• Provides operational feedback to AIM on systems performance, liability, and asset condition and health information from inspection and work program outcomes. • Provides AIM with asset and data information from completed jobs, and provides performance data and trends. • AIM provides GO with high-level and long-term outage requirements and coordination, and participates in constructability reviews of designed work.
Field & Grid Operations groups		
Construction Services Matt Wilson	Provides construction services to support the capital replacement, maintenance, and capital expansion of T&D, stations, and generation assets. Delivers an integrated bundle of services that supports specialized on-demand skilled construction trade needs. • Lower Mainland, Vancouver Island (Matt Wilson) • Southern Interior, Norther Interior, PPC Group (Guy Morand)	• Completes work in the field as directed by CIPD and PCM, as directed by AIM. Delivers core utility construction skills, namely: line, electrical, civil works, field mechanical work, and winder work. • The CS PPC group (Project Planning & Coordination) indirectly supports AIM at the project level, primarily through project management and delivery interface on all work AIM allocates to CS.
Real Time Operations Paul Choudhury	Manages and operates the primary control centre at Fraser Valley Office; responsible for developing operating procedures in consideration of safety standards, industry reliability criteria, equipment capabilities and environmental obligations.	
Regional Operations Lanny Sawchuk	Regional Operations is a provincial-wide group made up of tradespeople and the management and administrative people required to support them in their field roles. *Sub-groups:* • Distribution and Stations: Provides services that operate, maintain, repair, modify, refurbish, and replace distribution line and substation assets. Responds to trouble. Executes assigned T&D work in the field and ensures that customers get connected to the system. • Transmission: Provides services that operate, inspect, maintain, repair, modify, refurbish, and replace transmission line assets. Responds to	• AIM identifies work to be completed, while Distribution/Stations and Transmission execute the work. • NIA is the asset manager and engineering team for its generation facilities. AIM is the asset manager for distribution lines and substations in NIAs.

Functional Area	Roles	Coordination with AIM / Asset Management Role
	transmission lines-related trouble. Provides services that maintain and repair lead feeder cables, and acts as Subject Matter Experts (SMEs) in both transmission and cable work. Executes assigned T&D work in the field and ensures that customers get connected to the system. • Non-Integrated Areas: Supplies and distributes electricity to remote communities removed from the BC Hydro integrated system. Operates and maintains diesel generating stations, including one hydroelectric station and associated system facilities. Fosters community and aboriginal relations for BC Hydro.	
Smart Technology Operations & Restoration (STOR) Fiona Taylor	• Provides services that monitor, operate, troubleshoot, and manage intelligent field devices such as Smart Meters and Mesh Networks. • Provides operational and technology support services for the high-speed transport telecom network that supports the bulk power transmission system across British Columbia. • Manages routine outage/trouble events across the distribution grid. • Responsible for testing, installation, and management of BC Hydro's metering work across the Province. • Manages the Operational Technology Projects implementation lifecycle. *Sub-groups:* • Field Device Operations (David Deyagher) • Operations and Technology Program Office (Ranjan Raja) • Provincial Metering Operations (Doug Trapp): meter shop and field metering • Restoration Centre Operations (Mike Minichiello) • Telecom Network Operations • Telecom Support Resource Centre • Transmission Network Operatinos (Wayne Klein)	• Provides AIM with operational feedback on distribution system asset performance, using new sources of information from meters, CGRs, and other grid-related smart devices. • Provides AIM with operational services, field troubleshooting, and capital project support on the province-wide transport telecom network. • Accountable for providing accurate and complete outage information to support Reliability Metrics reporting. • AIM is key stakeholder in Operational Technology projects delivered by STOR, such as EMS, DMS, CROW, TTC, TSA, Synchophaser, GO-SIP. • AIM approves the ~$9M annual capital budget in support of OTprojects and other grid ops initiatives.
Trouble Operations Support Wayne Martell	Provides initial trouble response and troubleshooting expertise in the Lower Mainland and Victoria, in response to customer needs. Completes some maintenance/inspection work if required as part of trouble work. Responsible for storm response process improvements.	AIM identifies work to be completed, while TOS executes a portion of it.
***Program & Contract Management* (PCM)**		
Maureen Daschuk	Note: The PCM SharePoint Site is the best location to find information on the PCM organization: http://hydroshare/sites/dpp/default.aspx Executes distribution, transmission, and vegetation capital and maintenance programs: • Executes and manages all distribution capital programs (system improvement and end of life) and	**PCM**: AIM identifies work to be done in Capital/O&M Plans and provides the funding. PCM executes the work as a "general contractor" finding all the resources required to complete the work (internal and external), developing the

Functional Area	Roles	Coordination with AIM / Asset Management Role
	maintenance programs except for Smart Meter & Infrastructure project, emergent response, and routine customer connections. • Manages load distribution customer connections, distribution IPP interconnections, distribution assets shared with TELUS or others, third party relocations (distribution), and the Remote Community Electrification and Non-Integrated Areas projects. • Manages Distribution and Transmission Vegetation Program • Manages Transmission Lines and Stations Programs • Responsible for contract management and support activities related to distribution line, civil, vegetation, and technical services contractors. *Sub-groups:* • Civil, Engineering and Quality Management Contracts (Philippa Smith) • Distribution Line Contract Management (Duncan Ashwell) • Distribution Maintenance & Program Capital (Doug Juby) • Distribution Projects (Russ Dobie) • Portfolio Services *(previously Resource Strategy & Management under AIM)* (Bill Clendenning) • Transmission Capital and Maintenance Programs (Justin Malm) • Vegetation & Access Maintenance (Chris Smith)	schedules, reporting on the progress, and managing the contractors. **Portfolio Services**: Responsible for labour resource risk analysis and planning related to the capital, maintenance, and operational plans for the assets. In addition, Portfolio Services provides the resources that perform many of the tasks associated with administering the programs, including reporting.
T&D Human Resources		
Tracy Guterres HR for: • Transmission & Distribution • Safety, Security & Emergency Management • Training, Development & Generation	Offers strategic consulting services and best practice information in a variety of areas, including: • Strategy and workshop facilitation • Insights (team building, communication and personal development) • Leadership and employee development • Change management • Reward and recognition strategies • Workplace climate and effectiveness • Compensation management and job design • Succession planning • Attraction and retention strategies • Strategic workforce planning • Liaising with ABS: HR Services, HR Service Centre and Health Promotion • Collective agreement interpretation and application • Performance management (including performance feedback, discipline, development of competency frameworks, and analyses of skills/competencies) • Grievance management (except selection grievances) • Facilitating return-to-work arrangements and employee accommodations) (Also see Human Resources under 4.4.3, *Corporate Departments*.)	AIM provides high-level and long-term resource and skill requirements to suit the long-term plan.

4.3.3 Corporate and Other Departments

Table 3: Corporate and Other BC Hydro Departments: Functional Areas and Overall Roles

Functional Area	Roles	Coordination with AIM / Asset Management Role
Aboriginal Relations		
Al Leonard	• Responsible for establishing and implementing a corporate-wide approach to developing and sustaining long term relationships with First Nations. • Supports the company's goal to better understand First Nations' interests so that they can be incorporated, where possible, into its capital programs and business operations. • Assesses capital projects to determine if the Crown's duty to consult will be triggered as a result of any action undertaken by BC Hydro. Develops consultation strategies for the capital project and leads all First Nation consultations for BC Hydro as project proponents. • Establishes BC Hydro's Aboriginal Relations strategies, sets performance metrics, and reports to Executive Team and Board of Directors. • Ensures BC Hydro has policies and governance practices in place to support a coordinated and effective approach to First Nation risk management and Aboriginal relationship building strategies. • Facilitates each business function to fulfill its responsibilities to incorporate First Nations' considerations as per the BC Hydro Statement of Aboriginal Principles. • Advises BC Hydro business units on when and how to engage First Nations during our business activities. • Assesses First Nation grievances and determines the appropriate strategy to address them. • Ensures the accuracy and provides the witness for the First Nations-related content in BC Hydro's business and capital regulatory filings. • Develops strategies to integrate First Nations and Aboriginal relationship building into the fabric of BC Hydro's operations. *Sub-groups:* • Aboriginal Employment & Business Development (Laurie Sterritt): Helps attract and retain Aboriginal employees and businesses to work at BC Hydro directly or with our contractors. • Business Operations and Negotiations: (Danielle Van Huizen): Manages aboriginal relations' practices, including legal and regulatory compliance and business requirements. • Regional Relationships (three teams: North: Lindsay Thompson; Southwest: Hilary Dunn; Southeast: Jim Scouras): manage overall relationships with 203 First Nations in B.C.	Aboriginal Relations determines whether First Nations consultation is required for specific AIM projects. It leads the consultation on capital projects and long-term energy and transmission planning.

<table>
<tr><th>Functional Area</th><th>Roles</th><th>Coordination with AIM / Asset Management Role</th></tr>
<tr><td colspan="3">Capital Infrastructure & Project Delivery</td></tr>
<tr><td>Ken McKenzie</td><td>Leads the planning and execution of a multi-billion dollar portfolio of generation, transmission and substation projects, delivered safely, on scope, on budget, and on schedule.
Sub-groups:
• Capital Construction (Graham Fenwick)
• Columbia & Vancouver Island Generation Projects (Ken Talbot)
• Dam Safety Projects (Alex Selnes)
• Lower Mainland Transmission Projects (Bill Earis)
• Northern Interior / Southern Interior Transmission Projects (John Beggs)
• Northern Thermal, & Lower Mainland Generation Projects (Ken Talbot)
• Project, Program and Portfolio Services (Neil Kelly)
• Vancouver Island & BC Transmission Projects (Brooke Dutka)</td><td>CIPD supports AIM in asset investment planning and decision making:
• Provides input to AIM based on plant records management, technical equipment assessments, and studies.
• Prepares project estimates and project implementation plans based on the project scope provided by AIM for CIPD-delivered projects.
• Prepares standards consistent with the standards strategy developed by AIM.</td></tr>
<tr><td colspan="3">Corporate Affairs</td></tr>
<tr><td>Janet Fraser</td><td>• Partners with all areas of the company to develop company-wide plans so the entire company is focused and has clear direction.
• Sets out our long-term and short-term plans based on our shareholder's expectations, where the world is going, and what our customers want.
• Meets the long-term electricity needs of our customers cost effectively through the design and delivery of conservation and energy management programs and managing our third party contracts for electricity supply.
• Manages our relationship with our shareholder, and the regulator, and influences key policy decisions.
• Monitors progress on implementing our plans while identifying and managing key risks.
• Manages the internal and external narrative on BC Hydro through effective communications.
• Leverages our workforce to ensure that we have the right people with the right skills to execute our plans, and that we have an engaged, productive workforce.
Sub-groups:
• Business & Economic Development (Rohan Soulsby)
• Business Planning & Risk (Jeff Nugent)
• Conservation & Energy Management (Stephen Hobson)
• Customer Service (Keith Anderson) More info below.
• Energy Planning (Randy Reimann)
• Human Resources (Rick Milone) More info below.
• Policy & Corporate Relations (Chris Sandve) More info below.
• Regulatory & Rates (Tom Loski)</td><td>T&D asset management must align with BC Hydro corporate priorities and policies, including long-term reliability of the network at competitive rates, and planning and undertaking asset investments according to the Capital Plan. AIM also:
• Coordinates with Policy & Corporate Relations on employee and public messaging.
• Relies on assistance from Human Resources to manage people and plan for workforce needs.
• Collaborates with Energy Planning to support development of the Integrated Resource Plan.
• Builds KBU Business Plan with support from Business Planning & Risk.
• Collaborates with Conservation & Energy Management to support demand-side management initiatives</td></tr>
</table>

Functional Area	Roles	Coordination with AIM / Asset Management Role
		impacting system planning and asset management. • Relies on Regulatory & Rates for direction and advice on submissions to our regulators.
Corporate Affairs groups (relevant to AIM)		
Customer Service Keith Anderson	• Strategic priorities include offering service to customers through a commitment to service, communications, reliability, pricing, and public interest. The goal of the group is to make doing business with BC Hydro easy for customers overall. • Customer Service delivers customer solutions, including responding to customer inquiries around billing, service changes, power outages, and how to reduce consumption (including energy efficiency promotion directly to key accounts). *Sub-groups:* • Customer Analytics (John Millard) • Customer Service Operations (Daren Sanders) • Customer Strategy & Project Delivery (interim: Vickie Chan) • Key Account Management (interim: Janet Ruzycki, Lester Dyck)	AIM and Customer Service share information and resources as needed. For example, AIM liaises on issues of customer care and when handling key accounts.
Human Resources Rick Milone	• Provides employees with resources and support while ensuring that the business continues to meet its goals. • Manages broad-based programs that are holistic in nature, such as Total Rewards, Labour Relations, and the individual Business Group Human Resources. • Manages more customized programs to support employees, including Recruitment, Training Programs, and Talent Development. • HR Systems Planning and Reporting, Workforce Planning, and Accenture Business Services also provide support. *Sub-groups:* • Client Services – CIPD, Corporate Affairs, Corporate Groups, Finance & Business Services (Joanne Thomopoulos) • Client Services – T&D; Training, Development & Generation; Safety, Security & Emergency Management (Tracy Guterres) • Client Services – Powerex (Julie Mantle) • Engagement & Talent Management (Iwona Szpak) • Recruitment (Sean Mullins) • Employee Relations (Jeff Marwick) • Total Rewards & Systems (Lynne Foster)	AIM relies on assistance from Human Resources to manage people, including for recruitment, leaves, performance evaluations, and more.
Policy and Corporate Relations Chris Sandve	• **Communications**: Leads the development and delivery of information to the public and employees about BC Hydro's programs, projects, and initiatives. Leads relationships with local governments, the media, and other stakeholders. • **Policy**: Centralizes and coordinates policy	AIM coordinates with PCR on web-based corporate messaging, such as on planting near power lines. If municipalities have an asset-related concern, PCR

Functional Area	Roles	Coordination with AIM / Asset Management Role
	development to support the achievement of BC Hydro's vision and company-wide priorities as well as the objectives of the Provincial Government. Provides strategic direction and advice to Business Groups across BC Hydro in response to emerging government public policy developments, and oversees the preparation of reports. *Sub-groups:* • Policy & Research (Dina Matterson) • Planning & Employee Communications (Jenn Hartman) • Corporate & Marketing Communications (Cynthia Dyson) • Communities & Capital Projects (Lawrence Pillon) • Media Relations & Issues Management (Simi Heer) – includes smart meter communications.	acts as the front line person. They also help with public messaging around assets, and may be involved from a regulatory standpoint, such as publishing required ads.
Environmental Risk Management		
Karen Popoff	• Responsible overall to BC Hydro for environmental risk management. • Identifies emerging regulatory requirements and best management practices. • Creates and implements policies and standards that address environment and related social risks. • Accountable for delivering the Water License Requirements program, the Fish and Wildlife Compensation Program, real-time field support, project support, and regulatory oversight and compliance, working within an ISO-compliant type system. *Sub-groups:* • Environmental Field Services (Rian Hill) • Fish & Wildlife Compensation Program (Trevor Oussoren) • Land Program (Marianne Berkey) • Project Environment Risk Management (Gen Martin) • Water Program (Alison Briggs)	• AIM and ERM work collaboratively to ensure asset strategies are forward thinking to improve resources and the environment for the long term. • AIM engages ERM on strategies, projects, and programs with environmental aspects. • ERM seeks input from AIM when drafting new or updated environmental policies and standards. • ERM manages environmental regulatory relationships and negotiations. • ERM develops, delivers environmental training to support compliance. • ERM identifies environ-mental performance concerns and supports corrective actions. • ERM supports spill clean-up and mitigation of other environmental incidents. • ERM engages with AIM to deliver contaminated sites management program.
Finance & Business Services		
Cheryl Yaremko	The Finance group supports each business group with its strategic and operational requirements. This includes planning and budgeting, management reporting and forecasting, business case analysis, decision support, and	AIM coordinates in various ways with Finance & Business Services depending on the need and

Functional Area	Roles	Coordination with AIM / Asset Management Role
	general and revenue accounting. • Finance provides overall leadership and guidance on financial policy, processes, controls, documentation, performance reporting, training, and additional assistance to BC Hydro. • Supply Chain helps to obtain and maintain materials, vehicles, and services so that work can be safely and cost effectively done on time • Technology provides technology solutions to provide new capabilities, improve productively, enhance safety, and provide access to data in support of running our business *Sub-groups:* • Audit Services (Albert Lagnado) • Chief Supply Chain Officer (Guj Parmar) • Finance, Budgeting & Forecasting (Ryan Layton) • Finance, Capital, Generation & Corporate Groups (Michael Wynne) • Finance, Central Services & Operations (Carol Richards) • Finance, Site C (Elizabeth Fletcher) • Technology (Kip Morrison, Chief Information Officer)	circumstances.
Training, Development and Generation		
Mark Poweska	Maintains and operates BC Hydro's assets to generate safe, efficient and reliable electricity for BC Hydro's customers. • Manages investment strategies for generating assets that inform the 10 Year Capital Plan. • Coordinates agreements such as the Columbia River Treaty and the Canal Plant Agreement. • Directs market purchases and sales to keep rates low for our customers, and makes surplus capability available for Powerex to trade. • Provides learning and development opportunities to make sure our people have the right skills at the right time to be successful at BC Hydro. Provides and ensures the continuous supply of electricity to BC Hydro's transmission system. • Acts as stewards of the Heritage Assets, the massive engineering structures that use B.C.'s electrical generation resources. • Responsible for achieving BC Hydro's Generation mandate to fulfill our social and environmental obligations that form part of our license to operate • Meets B.C.'s power needs by drawing on these assets, those of IPPs, and when necessary through market purchases. Also makes any surplus capability available for electricity trade. *Sub-groups:* • Asset Management (Andy Darby) • Coastal Operations (Ray Stevens) • Columbia Operations (Richard Brittin) • Generation Maintenance (Chris Weyell)	AIM and TD&G work collaboratively as needed to ensure that the overall needs and requirements of the linked assets are met. At the detailed asset level, these interactions ensure that any linkages and dependencies between the assets are considered. At the portfolio level, the teams have a high degree of interaction to ensure that the corporate risk framework is applied consistently across the different portfolios, and support corporate planning activities.

Functional Area	Roles	Coordination with AIM / Asset Management Role
	• Generation Resource Management (Heather Matthews) • Learning Development & Trades Training (Tracey Armatage) • Peace Operations (Darin Thompson)	
Safety, Security & Emergency Management		
Hugo Shaw	Responsible for workplace safety within BC Hydro. Ensures corporate safety values are understood and implemented, oversees the Safety Management System, and develops safety plans and safety policies. Offers a variety of written safety rules, procedures, tools, and resources for employees. *Sub-groups:* • Field Safety Services (Dave Fox) • Safety Assurance (Duane Duhamel) • Safety Management System Portfolio (Patrice Rother) • Safety Program Management (Anthony Gamage and Stephen Murray) • **Security & Emergency Management** (Ben Peco) Provides risk-based security solutions, including setting security-related standards pertaining to our people, assets, and operations. Supports and coordinates BC Hydro's resilience, including preparedness and response to emergencies or disasters.	Requirements to protect safety are integral to AIM's processes for risk management, performance monitoring, and meeting reliability standards. Safe Engineering and Safety by Design principles should be incorporated into all "Design" activities. Asset managers and planners must follow processes analogous to those more typically performed by design engineers, technologists, and technicians to satisfy the BCH Safety Policy requirement for Safety by Design. Safety can help ensure that processes and tools developed adhere to correct principles for correct safety decisions. **Security & Emergency Management**: Provides security standards for AIM to adhere to. Supports AIM in the identification of risks and creation of related emergency response plans. Leading up to and during an event or incident, EM will engage and coordinate with AIM through BC Hydro's emergency management system and associated framework (i.e., emergency operations centre).

4.4 Responsibilities for Asset Policies and Strategies

The following RACI charts show the high-level responsibilities, accountabilities, and collaborations for various T&D groups involved in asset management.

RACI means "Responsible, Accountable, Consulted, Informed." The purpose of RACI charts is to identify and assign roles and responsibilities, define accountabilities, define who must be consulted or informed, resolve overlaps, and resolve gaps.

Legend:

R Responsible: The individual(s) responsible for action/implementation, including helping with the collaboration role.

A Accountable: The individual ultimately answerable for the activity or decision, i.e., with "yes" or "no" authority and veto power.

C Consultative or collaborative role: The individuals, typically subject matter experts, to be consulted prior to a final decision or action. Input from the designated position is required.

I Needs to be Informed: The individual(s) who needs to be informed after a decision or action is taken. It is a one-way communication.

4.4.1 Asset Policies, Strategies, and Standards

Table 4: RACI Chart: Asset Policies, Strategies, Standards

	Definitions	AIM[1]	Generation & Transmission Engineering	Field Operations	Work Methods and Trades Training	Grid Operations	Technical Working Groups	Safety	Distribution Design & Customer Connections	Program & Contract Management	Project Delivery
Policies											
Asset Policies	High-level and functional level Asset Management policies	A&R	C	C	C	C	I	C	I	I	I
Strategies											
Asset Strategies	High-level and functional level Asset Management strategies	A&R	C	C	C	C	I	C	I	I	I
Standards											
Planning	Provide the overarching architecture, topology, asset/technology and performance criteria.	A&R	C	I	I	C	I	I	I	I	I
Technical Specification	Provide technical requirements of equipment and materials that meet the performance criteria and asset strategies.	C A&R for Dist.	A&R	C	C	C	I	I	I	I	I
Engineering & Design	Provide the details that outline how the asset/system components are engineered, designed, and constructed.	C A&R for Dist.	A&R	C	C	I	I	C	I	I	I
Work Methods	Provide procedures for the safe maintenance and operation of assets.	C	C	C	A&R	I	C	C	I	I	I

	Definitions	AIM[1]	Generation & Transmission Engineering	Field Operations	Work Methods and Trades Training	Grid Operations	Technical Working Groups	Safety	Distribution Design & Customer Connections	Program & Contract Management	Project Delivery
Commissioning	Provide the procedures for commissioning assets.	C A&R for Dist.	A&R	C	C	C	I	I	I	I	I
Operating	System and local operating orders.	I	C	C	I	A&R	I	C	I	I	I
Maintenance	Define the frequency of inspection, testing, and maintenance, and specify procedures for maintenance, testing, and repair of existing assets.	A&R	C	C	C	I	I	I	I	I	I

4.4.2 Customer and Interconnection Policies and Strategies

Table 5: RACI Chart: Customer Interconnection Policies and Strategies

	Definitions	AIM	Project Delivery	Economic Dev'p	Customer Care (KAM)	Finance – Reg. Affairs
Tariff						
Interconnection tariff and policies	Develop new transmission and distribution extension policies and tariffs	R&C		C	C	A&R
Projects						
Interconnections Study timelines	Improve study timelines to better serve customers	A&R	R/C	C	C	C
Strategies						
Shared Assets	Develop strategies to improve commercial focus of Shared Assets	A&R	C		C	C

The Customer Interconnections & Policy (CI&P) team manages the Distribution Instructions, which describe required BC Hydro policies and procedures for functions associated with Distribution. CI&P is responsible for the full scope of products and services necessary to address the operating concerns of distribution customers, facilitate the increased load of existing customers, and connect new customers to BC Hydro's electric system. Through an integrated service delivery model, CI&P designs and constructs assets that meet current engineering standards and satisfy customer needs.

The *Distribution Instructions (DI) Manual* provides working guidelines to interpret and implement Distribution policies, and general information and guidelines to aid in decision making. DI policies and procedures include those on:

- Agreements
- Charges
- Distribution extension
- Lighting
- Metering
- Operating standards
- Permits
- Purchasing and stores
- Rates
- Service connections

4.4.3 APSS Committee and AIM Leadership Team

The APSS Committee (Asset Policy, Strategy and Standards) provides governance over the maintenance and development of standards, in particular for Transmission and Stations. The key objectives of APSS governance are to provide:

- Clear and well-understood decision-making authority
- Continuous linking of objectives and direction to Corporate and T&D business objectives, strategy, and direction
- Effective oversight of (and insight into) the direction, execution, and performance of asset policy, strategy, and standards, including the capability to prioritize and adjust as necessary
- Processes, frameworks, and tools to direct and control the outcome

For Distribution standards, policies, and strategies, the AIM LT (Leadership Team) is used as the *de facto* APSS Steering Committee. Integration and alignment is created for Distribution Standards through regular stakeholder meetings, such as with Asset Sustain, Planning, Work Methods, Design, and Field . Unresolved issues or conflicts are escalated through management hierarchy. A spreadsheet based on the APSS tool is used to track all Distribution Standards needs, prioritization, stakeholder engagement, and annual work plan. The Standards work plan is presented to AIM LT for review at least annually.

5.0 Asset Investment Planning

The objective of T&D AIM's asset investment planning is to ensure delivery of BC Hydro's approved performance objectives for assets. Asset investment planning:

- Outlines the long-term strategy for the asset class, taking into account the financial requirements for short, medium, and long planning horizons over the entire asset life cycle
- Details the commitments for maintenance (O&M) work planning and Sustain and Growth Capital plans, using data from asset condition monitoring and investment models
- Considers performance targets, risks, and growth opportunities, as well as the implications of any technology shifts or new body of knowledge across the industry

T&D uses an integrated planning process that addresses specific performance objectives, risk management (including safety, and contingency and emergency planning), and life cycle analysis. Success is measured by meeting specified targets for performance, reliability, risk, and safety at the lowest life cycle cost.

This section describes BC Hydro tools for asset investment planning, including:

- Capital plan
- O&M Plan (operations and maintenance)
- Sustaining Investment Model
- Integrated Resource Plan (IRP)
- Asset Health Index
- Technology Roadmap

5.1 Capital Plan

A Capital plan forecasts budgets for growth and sustainment over a 3-year period. Growth Capital refers to investments to expand or transform operations, such as construction of new lines and stations, and other major capital expenditures. Sustain Capital refers to investments required to maintain operations and system reliability and manage risks, including funds for equipment replacement, safety, and so on.

The capital planning process uses an integrated planning approach to identify and plan needs to create a portfolio of capital projects, taking into account the following criteria:

- **Growth:**
    - Regulatory requirements: BCUC, NEB, NERC, WECC, Measurement Canada
    - System and regional load growth
    - Transfer of power from new generation resources (i.e., new capacity additions)
    - Load and generation interconnections requests (and third party requests)
- **Sustain:**
    - Asset health and performance
    - Mitigation of significant risks (safety, seismic, environment, fire, weather)

From a corporate-wide perspective, BC Hydro files a Revenue Requirement Application (RRA) with the BC Utilities Commission as required (about every 1 to 3 years; here is the F17-F19 RRA). The RRA reflects the expenditures BC Hydro requires to operate, and applies for any needed rate increases.

5.1.1 Transmission Capital Planning

BC Hydro uses the bottom-up approach to identify specific transmission asset issues and risks that must be addressed. In addition, BC Hydro looks at the longer term trends in asset health and end of life asset expectations, then determines whether the amounts determined by the bottom-up approach are adequate for the long-term management of the transmission assets. To understand those long-term trends, BC Hydro uses a Sustaining Investment Model (SIM), which is based on an analysis of asset survival curves determined from the past performance of transmission assets. (See Section 5.3, Sustaining Investment Model.)

Transmission growth projects reinforce the bulk and regional portions of the transmission system to meet the capacity and energy transfer demands for firm domestic load, generation dispatch, and firm Point to Point deliveries. BC Hydro determines the transmission investments required to meet forecast peak demand and OATT service agreements, including load and generation additions. The solutions proposed seek to meet the needs identified while minimizing total cost over the life cycle of the assets. Growth investments typically upgrade or add station equipment and transmission lines.

Transmission Capital Growth projects typically include:

- Regional system reinforcement
- Bulk system reinforcements
- Station expansion and modifications
- Feeder position / section additions
- Generator interconnections
- Customer-requested projects

Transmission sustain projects replace, refurbish, and enhance transmission infrastructure capital equipment to meet safety, reliability, environmental, and regulatory standards. The Sustain Capital portfolio is focused on the efficient and cost-effective management of existing transmission equipment to maintain system reliability, mitigate identified risks, and address third-party requested projects such as line relocations.

Asset condition, asset age demographics, and failure rates are key inputs of the needs analysis that identify the level of work required to sustain and cost-effectively operate and maintain the existing transmission assets over their life cycle. Projects are also included within the Sustain Capital portfolio to mitigate known risks such as safety, environmental, extreme weather, seismic, fire, and security.

Transmission Sustain Capital projects typically include:

- Circuit breaker replacement
- Other power equipment replacement
- Protection and control equipment replacement
- Stations auxiliary equipment replacement
- Stations risk mitigation
- Telecommunications infrastructure sustainment
- Cable sustainment
- Overhead lines life extension
- Overhead lines performance improvement
- Overhead lines risk mitigation
- Overhead/underground relocations
- Rights-of-way sustainment

5.1.2 Distribution Capital Projects

Distribution growth projects include system expansion and improvement projects driven by capacity constraints to accommodate forecast load growth, and customer-driven projects to connect new customers to the distribution system, including generation interconnections. Typical examples include:

- Increasing capacity and transfer load at high risk locations
- Commercial and residential requests for system connections
- Transportation infrastructure expansions

The objective of system expansion and improvement projects is to maintain the integrity of the distribution system, support system performance, and mitigate risks, based on established BC Hydro standards and planning criteria. Planning criteria are designed to provide the required system capability at the lowest cost, while considering performance expectations, asset utilization, life cycle costs, environmental objectives, and customer requirements.

Each year, T&D prepares a substation load forecast that identifies peak demand for each distribution substation over a 10-year period. This provides a basis for capacity addition and system expansion requirements resulting from load growth and changing system performance needs. The forecast draws on a number of information sources, such as substation peak demand readings, temperature data, major expected loads, and planned incremental savings on a system-wide basis. As a result, the substation load forecast is a bottom-up projection for each substation and region.

Planning managers for customer-driven projects consider local area information, economic factors, business activity, and potential major projects in the service area. Alternatives are designed and evaluated in consultation with customers.

Distribution sustain projects include asset replacement projects that replace assets when they reach end of life, and system expansion and improvement projects that maintain or improve the distribution system based on reliability, safety, and regulatory compliance.

Asset replacement projects are intended to achieve overall lowest life cycle costs. An assessment of asset condition, historical failure rates, the risk of not doing the project, and the probable financial impacts of replacing versus not replacing an asset (cost versus potential savings) are essential factors in determining when assets will be replaced.

Typical distribution Sustain Capital projects include:

- Customer reliability projects
- Downtown Vancouver Redevelopment initiative
- Distribution automation projects
- Underground feeder cable replacements
- Wood pole replacements
- Live front transformer unit replacements
- Replacement of failing porcelain fused cut out switches
- Beautification of urban facilities
- NIA Distribution upgrades and replacements

5.2 O&M Plan

The O&M Plan (operations and maintenance) describes planned work over a 3-year period to maintain current assets, including:

- Condition-based maintenance
- Preventive maintenance
- Corrective action
- Engineering (study work, field support, and engineering support work)
- Facilities work (to maintain building operations, such as power and heat)
- Environmental programs and practices

O&M activities support all components of the T&D infrastructure, including circuits, lines and cables, corridors, vegetation management, substations, other facilities and buildings, meters, and NIAs. The budget amount for each area of work is included in the O&M Plan.

AIM is responsible for creating the O&M Plan in collaboration with Capital Infrastructure Project Delivery, Field & Grid Operations (FGO), Engineering, and Finance. AIM provides a top-down approach to the O&M Plan by prioritizing the items to ensure the assets meet their designed meet (to supply BC Hydro's customers), and are also sustainable over the long term.

The O&M Plan allows AIM to advance the vision of optimal asset utilization and care. Information gathered through the plan supports AIM in developing and managing not only equipment maintenance programs but also in planning capital expenditures. This allows coordination of maintenance work on assets with Growth and Sustain Capital programs to ensure safety and environmental goals are met while minimizing risk and costs, and maximizing reliability.

Types of T&D maintenance are as follows:

Preventive Maintenance: Consists largely of planned and scheduled maintenance for an asset, such as periodic oil changes required by the manufacturer, regular inspections, and sampling and testing programs. Every asset must have a PM plan. Also, maintenance standards are reviewed on a regular basis by Asset Planning and Strategy to ensure that optimal work is being performed to maintain the assets.

Condition-Based Maintenance: Consists largely of annually-planned repairs or replacements of defective or damaged T&D system facilities. Condition-based maintenance work is required when a component has experienced damage, wear, or decay but has not failed completely. The work is prioritized and scheduled by considering the component's condition assessment, the importance of the component to the system, due diligence, and the component's criticality. Condition-based maintenance also includes engineering, design studies, development design and maintenance standards, and maintenance of records and drawings.

Corrective Maintenance: Consists of any unplanned repairs or replacements of failed T&D equipment and systems that need to be returned to service immediately. As this work is unplanned, it is not specifically identified in the annual work plan and the budget is established based on recent trends.

5.3 Sustaining Investment Model

BC Hydro uses a Sustaining Investment Model (SIM) to help plan long-term investment strategies and requirements. The asset health and performance portion of the Sustain Capital plan is closely aligned with the outcome of the SIM.

The SIM is based on the predicted number of assets reaching the end of their useful life in each year. It uses failure rate data taken from actual equipment history, manufacturer's data, and expert knowledge.

Significant outcomes from using the SIM are:

- Age demographics of assets have a significant impact on life-cycle investments (e.g., the lasting impact of the investment bubble from the 1960's and 1970's).
- Investment strategies reflect the life cycle of utility assets (e.g., the very long life cycle of transmission assets means that the SIM results in a 100 year and beyond life-cycle view).
- Correlation of the levels of investments with asset performance creates transparency for shareholders and regulators.

The SIM is continually enhanced through ongoing validation and calibration work to refine the model's accuracy and consistency as more data becomes available. The SIM uses the following data:

- Demographic data for each asset type and class
- Historical failures and retirements that indicate the end-of-life dates for equipment
- Asset health indices (AHI)
- Replacement costs for assets in present value

Using this data, the levels of investment for Sustain Capital can be forecasted. SIM provides a strategy to anticipate and mitigate the future likelihood of substantial cost increases. The purpose of asset management strategies is to mitigate such cost increases by taking pro-active action to manage assets more effectively, extend the life of assets, and replace assets at lower costs.

5.4 Integrated Resource Planning

BC Hydro's Integrated Resource Plan (IRP) presents a set of future actions to ensure that customers continue to receive cost-effective, reliable electricity with manageable risk. The IRP includes a 30-year assessment of infrastructure and capacity needs for electrical transmission, including an assessment for the potential of developing clean or renewable resources.

In an IRP, new potential resources (both demand-side management and supply-side resources) are identified for serving future electricity requirements over a range of load forecasts and discrete load growth scenarios. In considering alternative portfolios of new generation resources, BC Hydro also needs to consider the costs and other impacts of the associated requirements for transmission system reinforcement. Given the significant number of portfolios to be analyzed, the needs for meeting reliability criteria are chosen from a relatively small set of alternatives with different capabilities and costs.

The development of BC Hydro's IRP is multidisciplinary in nature and involves various departments across BC Hydro, including T&D AIM. BC Hydro also seeks and considers input from First Nations, the public, and stakeholders, including many of its key customer organizations.

The IRP results in the development of a Base Resource Plan (BRP) and a set of Contingency Resource Plans (CRPs) as per BCUC's Resource Planning Guidelines. Under the Open Access Transmission Tariff (OATT), BC Hydro must act as a "Transmission Customer" to request transmission service from BC Hydro acting as the "Transmission Provider" (administered by Field & Grid Operations). This is referred to as Network Integration Transmission Service (NITS), which is the transmission service BC Hydro uses to serve its domestic customers. See Part III of the OATT for information on the application process and requirements for a NITS agreement.

The BRP and CRPs are submitted to the Transmission Provider as part of a NITS application and this process triggers two study phases:

- System impact study that identifies the transmission reinforcements needed to provide the required service
- Facilities study that provides estimated costs and construction schedules for the associated transmission network upgrades identified in the SIS

5.5 Asset Health Index

The Asset Health Index (AHI) is an evolving tool that assesses the current and future asset health based on a number of weighted factors, such as remaining useful life, maintenance, replacement costs, current maintenance practices and standards, wear and tear, known defects, and regional variations. The AHI uses statistical measures to provide a transparent, repeatable, and measurable methodology to assess the health of an asset class and aid in sound investment decisions.

BC Hydro revised its methodology for determining Asset Health in 2013. The intent is to better align BC Hydro's asset management view with the actual state of the asset. This provides BC Hydro's senior management with as reliable a picture as possible of the current health of the assets to improve system management and help ensure accurate work planning and budgeting. It also aligns with and supports the application to the regulator, the BC Utilities Commission. Expanded data collection for use in the new methodology has been underway for since 2011 and continues to grow.

BC Hydro determines Asset Health by performing standardized condition assessments in the field as part of the maintenance program. Asset managers then take that condition assessment and factor in the field feedback and expert judgment from the engineering assessment, as well as the asset's age, life curve, and performance to calculate the Asset Health Index (AHI). The result is an index of asset health to align with asset management that reflects the actual state of the system.

The AHI methodology is transparent, repeatable, and measurable. It involves:

- Providing general descriptions of each asset class
- Preparing demographic profiles of each type of asset
- Describing condition assessment techniques for each asset class
- Determining end-of-life criteria based on condition assessments of each asset class
- Formulating the Asset Health Index using data from asset health, age, and life cycle
- Calculating a numerical condition score for members of each asset class to indicate their suitability for continued service
- Ensuring repeatability by documenting the methodology and data sources used

The results are used to help make decisions on the risk and consequences of an asset's criticality issues, reliability goals, compliance requirements, and performance expectations.

T&D Assets - All	Asset Count	% of Asset
T&D Assets - All	3,983,628	
Transmission	125,271	
Substation	48,122	
Distribution	3,810,235	

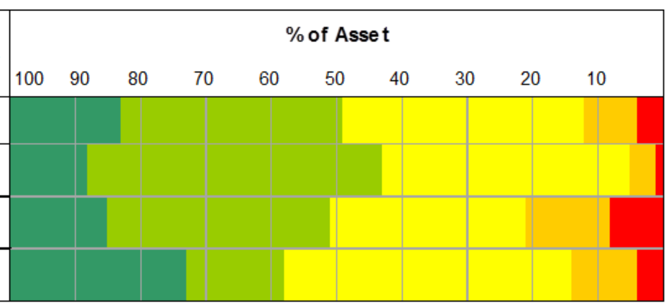


Figure 7: Asset Health Index Summary for All T&D Assets

(Source: Asset Health Index Report, F2016 Q4)

Computing the Asset Health Index (AHI) requires end-of-life criteria for the asset or various components of the asset class. Each criterion represents a factor critical in determining the component's condition relative to potential failure. The AHI cannot, however, predict remaining life of an asset.

The exact meaning of the condition rating is different for each given asset class or components within it, depending on the asset's physical characteristics and how deterioration might progress towards end of life or failure.

Table 6: Asset Health Index Ratings

AHI	Description	Requirements
Very Good	Some aging or minor deterioration of a limited number of components	Normal maintenance
Good	Significant deterioration of some components	Normal maintenance
Satisfactory (or Fair)	Widespread significant deterioration or serious deterioration of specific components	Increase diagnostic testing; possible remedial work or replacement needed, depending on criticality. Action required beyond 10 years.
Poor	Widespread serious deterioration	Start planning process to replace or rebuild, considering risk and consequences of failure. Action required within 4-10 years.
Very Poor	Extensive serious deterioration	Replace or repair is likely needed. Action required within next 3 years.

For detailed information on the Asset Health Index, see the *Asset Health Index Report* (2016 Q4 – Note: link may not be accessible to all).

5.6 Technology and Future Needs

5.6.1 BC Hydro Technology Plan

BC Hydro's Technology group is responsible for the planning, design, delivery, operations, support, and management of BC Hydro's information and communications technologies. The group supports and enables the business through sustaining and enhancing existing systems and assets, building new capability, and preparing for the future technology needs of the organization.

Projects and activities related to managing risk include replacing obsolete infrastructure, renewing applications platforms, regulation compliance, and incorporating redundancy into critical assets.

The BC Hydro 5-year Strategic Plan (F17-F21) is a five-year view of technology solutions funded or resourced by the Technology Group. The Plan is comprised of an Executive Summary, a Portfolio Plan and an Operations Plan. The plan summarizes the technology priorities over the next five years, such as implementing continuous improvement toward service excellence in performance, availability, and reliability; and using advances in technology to meet performance objectives and maintain and support robust core systems.

5.6.2 Asset Registry

T&D AIM uses the "One Asset One View" strategy to track and collect asset management data. Although data exists across a wide variety of applications in use by groups or individuals within BC Hydro (e.g., SAP, Passport, STARR, SCADA, etc.), it is not considered current or accurate unless the data producer/collector has submitted the data to the central Asset Registry, which acts as the data custodian.

The objective of the Asset Registry is to act as a single data source that can convert the operating and maintenance data into useful information for asset management decision-making. Specifically, this means taking data such as asset condition, age, historical performance, life cycle, and criticality, and using them to determine the AHI, the probability of failure, expected remaining life, and finally, the forecasted asset performance and system risks.

5.6.3 Research and Development

BC Hydro's technology strategy is to use proven, economic technologies to grow and sustain assets, serve customers, and improve compliance, efficiency, and reliability, as well as mitigate system risks. The overall goal of research and development is to create business value through the research, demonstration, and implementation of technology innovations that enhance the reliability, efficiency, and public acceptance of electricity transmission in BC.

BC Hydro invests in new technologies to meet the following business objectives:

- Develop the T&D system to maximize transfer capability, reduce losses, and enable electricity security and self-sufficiency.
- Plan and construct T&D system expansions more quickly and with improved lifecycle performance and cost.
- Manage existing assets and rights-of-way to achieve reliability objectives and minimize long-term maintenance and sustainment costs.
- Reduce impacts of physical and operational risks (natural and human).
- Collect and communicate high-value operational and asset condition information, and provide related analysis tools to support effective decision-making by system operators, asset managers, and planners.
- Address emerging sustainability concerns and ensure public acceptance of BC Hydro's operations and long-term capital and asset investment plans.

5.6.4 Customer Connections

The technology plan for customer connections includes plans for IPP connections, transmission, and large distribution load connections. IPPs are connected on request as prescribed by the *Clean Energy Act*, while customers are connected as prescribed by the Electric Tariff.

Because the volume of such interconnection requests cannot be reliably predicted in advance, the Interconnection and Shared Assets group (I&SA) makes high-level estimates based on any known information about future needs, as well as anticipated expansion needs of existing IPPs. Interconnection requests from secondary use customers (of transmission rights-of-way) are granted at the discretion of I&SA, provided they do not interfere with BC Hydro objectives of reliability, safety, and performance.

For distribution assets, external customer requests must be responded to within reasonable time frames, and must be coordinated with operational requirements and other asset management activities (e.g., pole replacement programs, TELUS needs on jointly-owned poles, etc.)

6.0 Asset Management Policies

Note: BC Hydro's overall Asset Management Policy was finalized in January 2014, and is reproduced on page 22 of this document.

Asset management policies are the foundation of the AMF and apply to all T&D system assets. The policies provide direction on implementing the AMF for effective planning, design, construction, operation, maintenance, replacement, and decommissioning of relevant assets. The policies consist of both high-level and functional level asset management and customer (interconnection) policies.

Asset management programs, initiatives, and investments must follow the policies defined below in order to meet:

- Reliability standards
- Safety standards
- Availability requirements
- Regional adequacy guidelines
- Efficiency needs
- Environmental requirements
- Security standards
- Regulatory requirements
- Customer requirements

Policy 1: Asset Management Framework: BC Hydro T&D defines the scope of its Asset Management Framework and establishes, documents, implements, maintains, reviews, and periodically improves the framework to ensure its continuing suitability, adequacy, and effectiveness.

Policy 2: Asset Management Governance: To enable BC Hydro T&D to direct and participate in decision-making on the management of its assets, T&D establishes, documents, implements, maintains, and communicates asset management governance in line with:

- Corporate policies
- Strategies and objectives
- Requirements of the shareholder, First Nations, stakeholders, and customers
- Risk tolerances
- Applicable regulatory, statutory, and legal requirements

Policy 3: Asset Management Human Resourcing: BC Hydro T&D establishes and maintains asset management roles and responsibilities, and acquires adequate, competent, and trained resources (internal or external) to achieve the asset management policies, strategy, objectives, and plans.

Policy 4: Asset Management Strategy, Objectives, and Plans: BC Hydro T&D establishes, documents, implements, and maintains:

- A long-term, sustainable asset management strategy
- Objectives with measurable outcomes to support the assets and the Asset Management Framework
- Plans to achieve the strategy and objectives across the asset life cycle (from asset need identification to asset retirement), and maintain the continuity of critical asset management activities

Plans also include contingency plans to identify, respond to, and recover from incidents and emergency situations.

Policy 5: Risk Management: BC Hydro T&D establishes, implements, and maintains risk management processes and a risk management methodology (consistent with the corporate risk framework) to identify, analyze, evaluate, mitigate, monitor, and report risks and controls throughout the asset life cycle to make risk-based decisions.

Policy 6: Processes and Procedures: BC Hydro T&D establishes, implements, and maintains processes and procedures for the implementation of asset investment plans and the control of activities across the asset life cycle, consistent with the governance and functional roles defined in the governance framework. Because of the large volume and variety of work performed on distribution system assets on a daily basis, extensive process and procedure documentation and instructions are maintained to ensure that all work complies with the overall asset management strategy. Process documentation is also balanced with training and knowledge management.

Policy 7: Performance and Management Reviews, and Continuous Improvement: To achieve performance objectives and continuously improve performance, BC Hydro T&D establishes, implements, and maintains processes and procedures to:

- Monitor and measure the performance of the asset and management framework.
- Investigate asset-related failures, incidents, and non-conformities.
- Evaluate compliance and perform audits.

Policy 8: Information and Records Management: BC Hydro T&D establishes, implements, and maintains asset management systems and databases to:

- Support decision-making across all phases of the asset life cycle.
- Make information available to stakeholders to meet their requirements.
- Maintain up-to-date documentation to ensure that the Asset Management Framework can be adequately understood, communicated, and operated.

7.0 Asset Management Strategy

A key component of the Asset Management Framework is the *T&D Asset Management Strategy* document, which describes the asset strategies and work programs for the BC Hydro T&D system and its assets. For each asset class, the strategy brings together performance, financial, and risk objectives with the goal of achieving the lowest cost over the life cycle of the asset. Further comprehensive information is provided on all asset classes to provide accurate direction and guidance for producing specific asset management objectives and plans.

BC Hydro's strategic approach to asset management includes managing an asset over its entire life cycle, integrated planning using a cross-functional approach, adherence to industry reliability standards, and innovation. Various asset management processes, methodology, and tools are used to fulfill objectives, including several databases, an Asset Health Index tool, a criticality evaluation tool, a Sustainment Investment Model to develop long-term strategies, a reliability-centred maintenance methodology, and risk management assessments. The strategy also leverages innovative technology solutions where appropriate, such as the Smart Grid with its distribution automation and smart meters.

The asset management strategy flows from the asset management policies described above, and is intended to provide a big picture summary of strategic direction for the entire T&D system. The strategy aligns with the PAS 55 specification and is consistent with ISO 55000:2014. Since 2012, the strategy has been significantly refined and expanded and is updated each fall as new information and technologies become available.

Part One of the Strategy provides an overview of the transmission and distribution systems and their infrastructure, the strategic approaches to asset management, and the various processes and tools to enable effective asset management.

Part Two includes an individual asset management strategy for each major asset class, in the transmission, stations, and distribution portfolios. Each strategy includes detailed information on the asset class and how it is managed, including a description, objectives, KPIs, asset count and condition, risks, future requirements, required capital and O&M investments, and so on.

7.1 Transmission Strategy

Transmission infrastructure includes the transmission lines, underground and submarine cables, and support structures such as towers, substations, and telecommunication systems located throughout the province. Vegetation management and access infrastructure are also included in the asset base.

BC Hydro monitors the condition and performance of each of the transmission assets. Recent condition assessments indicate that many parts of the system are exhibiting signs of deterioration and an increasing number of components are approaching end of life as a result of normal wear and tear.

Substation Strategy: A significant number of different assets are included in the stations portfolio, ranging from power transformers and circuit breakers to auxiliary equipment such as batteries and fire suppression systems. All assets in the substation are integrated into a single system. An integrated approach to planning and maintenance improves efficiency and helps to ensure that the right decisions are made at the right time.

In addition to the need to manage together the individual assets in a station, good asset management involves also being aware of how each station interacts with the other stations around it and the lines that interconnect them. By viewing each asset system as a subsystem within a greater whole, the interconnections and interrelationship become apparent, allowing for more innovative alternatives and better decisions.

BC Hydro takes a station-focused approach to asset management, looking at all the work required at a station, and then grouping that work for efficiency. The management of stations is also integrated with BC Hydro's future needs during regarding station, transmission, and distribution planning.

7.2 Distribution Strategy

Distribution assets are managed through the effective and efficient application of life cycle asset management principles and practices. T&D AIM currently plans for maintenance and capital replacement programs from the bottom-up, based on the ability of each asset to meet its intended purpose (related to safety, reliability, and sustainability).

To ensure these purposes are achieved throughout the life cycle of an asset, Performance Standards, Maintenance and Condition Assessment Programs, and End-of-Life Replacement strategies have been developed, all following industry-accepted approaches such as reliability-centred maintenance (RCM). Several analysis tools are used in the asset planning process, and IT data gathering and reporting tools are used to support the planning process and managing the assets.

The Distribution asset base covered in this strategy document includes overhead and underground lines, poles, overhead and underground transformers, street lights, manholes, vegetation management, and access infrastructure.

7.3 T&D Growth Strategies

The *T&D Asset Management Strategy* described above is focused mostly on the Sustain side of the business. The following three standalone documents are strategies related to Growth planning and implementation.

7.3.1 System Transmission Studies Guide

The *Transmission System Studies Guide* describes the study process and the technical and economic aspects involved in transmission planning at BC Hydro. It is structured to take the reader through the steps of data preparation, technical studies, identification of reinforcement alternatives, and recommendation of projects.

- Section 2 discusses the sources of study data.
- Section 3 discusses reliability standards for system performance.
- Section 4 describes the technical studies undertaken by BC Hydro using the planning study data and reliability standards.
- Sections 5, 6, and 7 discuss aspects of identifying system reinforcements, the benefits of these reinforcements, and the economic methods for evaluating system reinforcement alternatives.
- Section 8 describes how a project recommendation is made from the various alternatives.
- Section 9 discusses the final steps of system transmission planning, project application, and operating studies that follow project approval.
- Section 10 provides a brief discussion on Mandatory Reliability Standards and BC Hydro's compliance requirements.
- Four appendices include detailed reference documents for various aspects of system planning studies.

7.3.2 Engineering Planning Guide

The *Engineering Planning Guide for Stations, Protection & Control, and Telecommunications* is a high-level summary of planning requirements for all BC Hydro projects related to substations, protection and control, and telecommunications. BC Hydro provides a Scope of Work for each project definition, and contractors will use this Guide together with experience, knowledge, and Good Utility Practice to deliver the project.

7.3.3 Distribution Planning Practice Manual

The *Distribution Planning Practice Manual* provides planning criteria consistency among regional districts in B.C. and guides planners and field service engineers in the way they plan a modern grid.

- Chapter 1 documents the Asset Management Framework for distribution planning, which specifies the objectives, performance requirements, and long-term distribution planning process.
- Chapters 2-3 provide updated and new guiding criteria for distribution planning including primary system configurations, system expansion, voltage regulation, and distribution losses, as well as distribution system protection, control and automation, and distributed generation.

8.0 Risk Management

This section provides an overview of the importance of risk management, and describes how BC Hydro (and T&D AIM) carries out risk management – a critical process in BC Hydro operations, including asset investment and management.

8.1 Objective of Risk Management

The key objective of risk management in T&D AIM is to ensure that T&D assets are managed through risk-based decision-making. Risk management provides an optimal link between performance and investment, ensuring that investment decisions to maintain and improve the performance of T&D assets take into account the following risks:

- Safety and health of workers and public
- Environmental impacts
- Reliability and power quality
- Regulatory compliance
- Financial
- Security
- Reputation
- Time and costs

8.2 Risk Matrices

The risk management framework shown in Figure 8 is based on BC Hydro's Corporate Risk Matrix. This is a governance tool that specifies the level of the organization to which a risk should be escalated for discussion and acceptance. T&D uses the Corporate Risk Matrix to evaluated risks related to existing assets. In addition, the Capital Plan and O&M Plan are both prioritized using the matrix.

The two dimensions used to calculate risk are:

- Severity of consequence: Potential loss or damage from an event type
- Frequency of occurrence: Expected frequency of a given level of loss or damage

The different consequence types represent different risk factors, which in turn represent the different stakeholder interests. They intersect where a given level of consequence meets a given level of frequency, which defines the level of risk from that event type. The risk assessment results in a numerical ranking from 2 to 16, with 16 being the highest risk.

The Environmental Scoring methodology in the matrix was substantially changed in F2016. For details, see page 2 of the matrix , as well as the *Environmental Consequence Severity Scale – Application Guide*.

Two additional risk matrices are used by T&D, both derived from the Corporate Risk Matrix:

- The Capital Allocation Risk Matrix is similar to the Corporate Risk Matrix but provides finer gradations of risk ratings and financial loss categories. It is enabled by the Capital Investment Analysis Guide, which supports a risk-based process to prioritize capital investments across BC Hydro.
- The Project Delivery Risk Matrix is used to evaluate risks related to the successful delivery of projects. This risk matrix is embedded in the Risk Register within PPM Workspace.

8.3 Definitions

Asset / system risks are risks related to the assets or system that could result in the assets or system not functioning as expected to meet performance objectives. Examples include known design flaws in equipment, system overload, equipment theft, and fire.

Project risks are risks that could result in a project not meeting its objectives. Examples include environmental incidents, safety incidents, and public opposition.

Organizational risks are asset management system (including overall management) risks that could result in T&D AIM not meeting its objectives – non-asset/system risks. Examples include high employee turnover, inadequate information systems, and regulatory non-compliance.

8.4 Enterprise Risk Management Framework

The Enterprise Risk Management (ERM) model shown in Figure 8 is a set of interrelated activities and rules for coordinating and directing risk management processes. ERM includes risk management activities across BC Hydro, and is made up of governance, processes, and reporting. The risk management framework complies with BC Hydro's Risk Management Policy and also aligns with ISO 31000, the International Standard for Risk Management.

T&D AIM uses the ERM model to identify, analyze, treat, and monitor potential risks throughout the asset life cycle. The framework is applied by ensuring appropriate actions during the asset life cycle and providing balance between performance, investments, and asset risks. T&D AIM management also escalates risks to the appropriate level according to corporate risk communication guidelines.

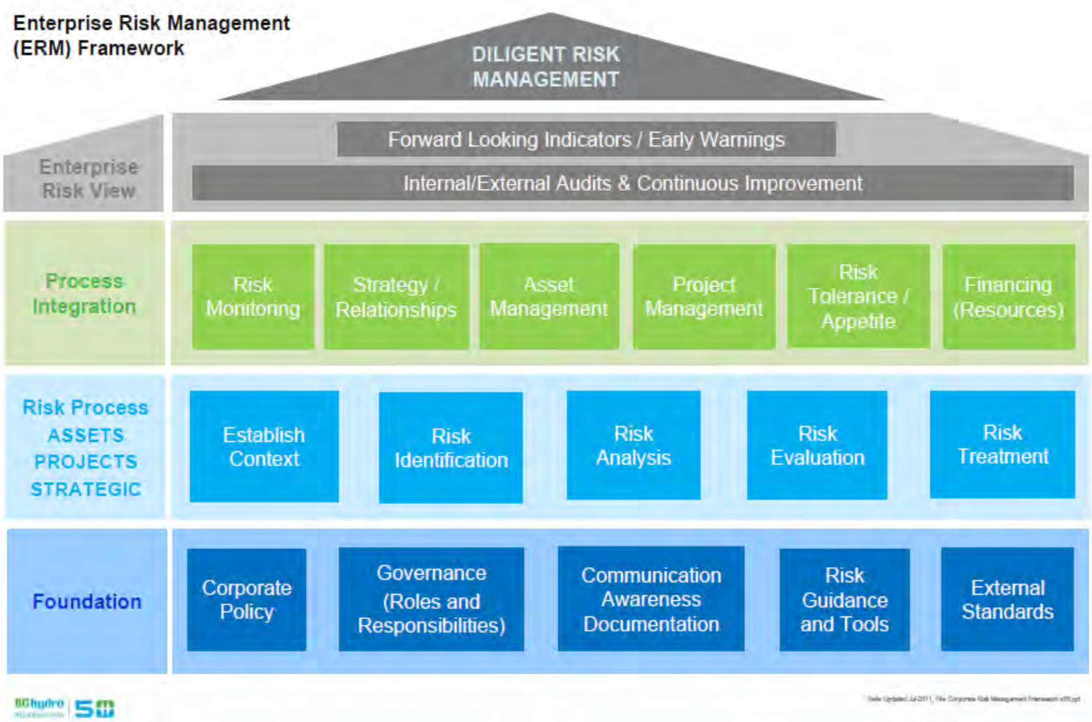


Figure 8: Enterprise Risk Management Framework

8.5 Key Elements of Risk Management Process

Key elements of T&D AIM's risk management process are shown in Figure 9, with more detail on each element below the table. This process is critical in meeting asset management objectives; therefore, risk management is embedded into every activity and process in the asset life cycle.

The risk management process is also used to set asset strategies and plans, define common business cases and alternatives analyses, prioritize investments, and make decisions on capital and O&M expenditures.

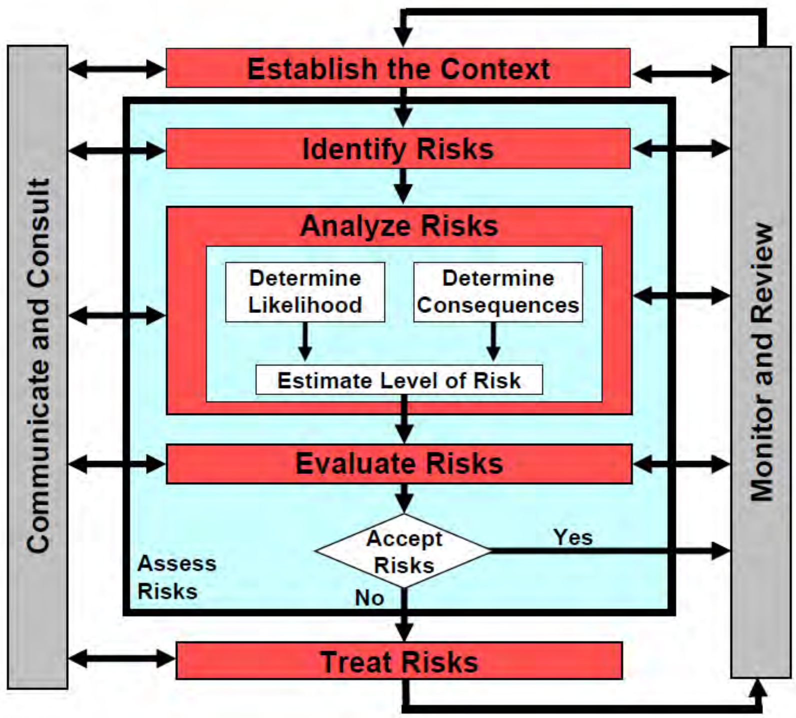


Figure 9: Risk Management Process

Establish the context: Define objectives against which the problem (risk or issue) will be assessed. Consider external environment and internal stakeholders. Think about how the project is to be delivered (e.g., within a maintenance window).

Identify risks: Identify where, when, why, and how events could prevent, degrade, delay, or enhance the achievement of objectives.

Analyze risks: Classify the identified risks into three categories: hazard, risk event, or consequence. Use of the Bow-Tie can assist in this exercise. Where possible, align consequences to general types such as financial, safety, environmental, and reputation. Estimate the severity of consequence and likelihood of occurrence.

Evaluate risks: Determine which hazards, risks, and consequences can be accepted, and based on those remaining, which will require treatment. Routine hazards/risks can often be accepted with existing controls. Investigaiton may be required to confirm if existing controls are adequate. When possible, plot on BC Hydro Corporate Risks Matrix to assist in escalating decisions to the appropriate level based on the risk level.

Treat risks: Determine the treatment options for each issue: avoid, transfer, mitigate, and/or control. Structured Decision Making (SDM) can assist in determining the appropriate treatment option. Each risk should be assigned an “owner” who is best equipped to manage it. After treatment, there will always be residual risks.

Monitor and review: To evaluate effectiveness and ensure continuous improvement, monitor and review all steps in the process. Also, establish appropriate control points with key indicators to ensure that all risks and treatments are visible and that new risks are assessed and treated. Hazards, risk events, and consequences will change through the lifecycle of a project.

Communicate and consult: Create a communication plan for both external and internal stakeholders and engage in appropriate communication and consultation at each stage of the risk management process.

9.0 Communications and Consultation

This section describes T&D's Communications Plan, and how BC Hydro (and T&D AIM) consults with First Nations and stakeholders – a key process in BC Hydro operations, including asset investment and management.

9.1 Communications Plan

The *T&D Asset Management Communications Plan* is a tool to help ensure that key stakeholders impacted by T&D Asset Management (AM) programs are regularly and effectively informed of relevant issues. Stakeholders are both internal and external to BC Hydro.

The objectives of the Communications Plan are to:

- Comply with PAS 55, the industry standard for asset management, and provide evidence of that compliance
- Ensure that required communications related to asset management are comprehensively covered, including both Asset Sustainment and Asset Growth.
- Ensure that all participants in asset management are consulted and informed so they are able to understand AIM processes and help identify gaps in systems and assets.

Key drivers for communications in asset management include policies, strategies, and standards; the Asset Health Index; the Capital and O&M plans; current work plans; gaps in addressing the assets; and alignments with Generation on its strategy and framework.

The main part of the Communications Plan consists of a Communications Matrix (table). Each group within AIM has its own table in the matrix. The information on communications recorded includes: summary of the message, the medium, the target audience, message delivery schedule, responsible personnel, follow-up activities, measurement for success, and feedback or other issues regarding the message.

9.2 First Nations Consultation

Consultation with First Nations is required for any BC Hydro project or activity that may potentially infringe on existing or asserted aboriginal rights.

Consultation must occur early in the planning process prior to decisions that may affect aboriginal rights. This includes consulting on BC Hydro's Integrated Resource Plan. Project consultation must include the review of alternatives. BC Hydro's regulator and the courts require evidence of consultation on alternatives.

Planning must consider the types of land ownership, such as Crown, Reserve lands, Treaty lands, and the associated rights of First Nations. The ongoing resolution of treaties in British Columbia will continue to limit the available options for the development of ROWs.

A Memorandum of Understanding between BC Hydro and the Government of B.C. provides for coordination of the consultation on permitting applications and the sharing of information, including consultation records.

T&D AIM complies with the requirement to consult with First Nations.

9.3 Government Stakeholders

BC Hydro engages with a range of government stakeholders on issues and projects where they may have an interest or stake. Interested government agencies and departments are kept informed of the status of projects and are consulted on key issues that affect them.

The primary provincial government stakeholders that BC Hydro engages with include (but are not limited to):

- Ministry of Energy and Mines
- Ministry of Environment
- Ministry of Forests, Lands and Natural Resource Operations
- Ministry of Aboriginal Relations and Reconciliation
- Ministry of Jobs, Tourism and Skills Training
- Ministry of Transportation and Infrastructure
- BC Safety Authority
- WorkSafe BC

The primary federal government stakeholders that BC Hydro engages with include (but are not limited to):

- Canadian Radio-television and Telecommunications Commission (CRTC)
- Environment and Climate Change Canada
- Fisheries and Oceans Canada
- Indigenous and Northern Affairs Canada
- Parks Canada
- Transport Canada

Local government stakeholders that BC Hydro engages with include:

- Municipalities (mayors and town/city councils)
- Regional Districts

9.4 Public Engagement

BC Hydro is accountable to British Columbians to take care of the environment, meet community needs, and deliver excellent financial results. As such, we pursue a path of sustainability by balancing, tracking, and measuring performance along environmental, social, and economic bottom lines.

Every three years, BC Hydro prepares a Service Plan to present to the B.C. Legislature under the *Budget Transparency and Accountability Act*. The plan outlines BC Hydro's vision, values, and objectives, along with key strategies and the results it expects to achieve in the next three-year period. The performance measures support BC Hydro's commitment to the triple bottom line, and allow the legislature and the public to track the company's progress over time.

Each year, BC Hydro also prepares an annual report that integrates both the annual report and triple bottom line reports into one comprehensive document that provides the public and shareholders with information on our economic, environmental, and social performance.

We strive to be socially responsible by developing and fostering healthy relationships with customers and other stakeholders. For example, we seek products, services, and new supplies of energy that take into account social responsibility and economic value to communities. Another example of BC Hydro's efforts to work with customers is the Community Grants program, which provides small grants to not-for-profit groups and charities supporting a more energy-conscious, prosperous B.C.

BC Hydro supports public engagement on its projects because of the importance of providing information and obtaining public input on planning, policy, and infrastructure decisions that affect the public interest. We strive to understand public perspectives so that local knowledge and needs can be incorporated into the project planning process. While public engagement is not always necessary, it is often desirable or even mandatory depending on the project. Public input can be effectively used to select preferred alternatives or make adjustments to the project that maintain good customer relations while still meeting BC Hydro's operational requirements. The public is kept informed as engagement progresses, including how input is considered and used.

9.5 Change Management

The goal of the Enterprise Change Management group (part of Corporate Affairs) is to support BC Hydro in achieving its goals and outcomes, while minimizing impacts to performance by planning, managing, and facilitating change. This is achieved through:

- Applying a structured approach and methodology
- Creating conditions and opportunities for change
- Minimizing performance decline during transition

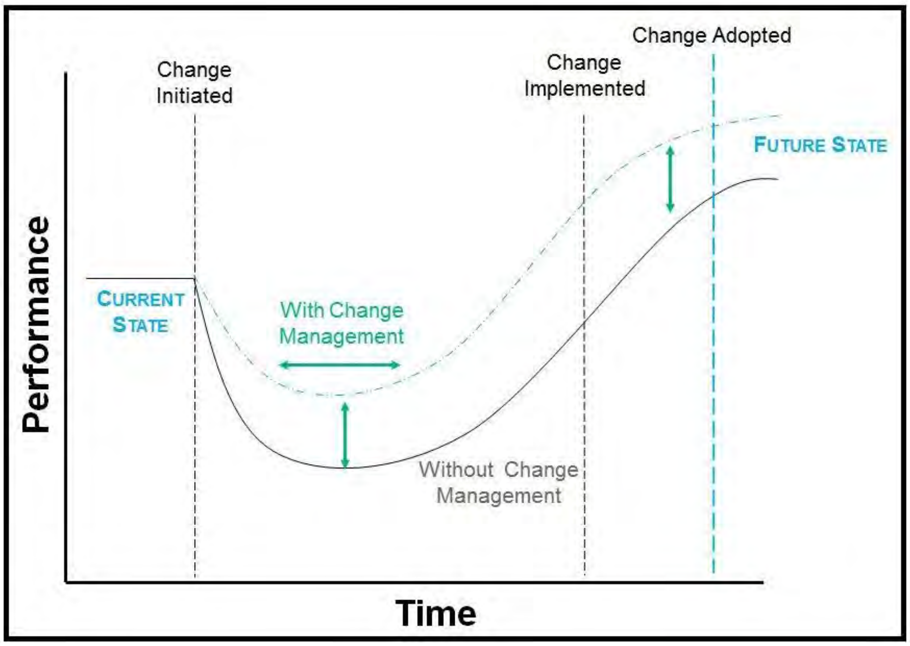


Figure 10: Change Management Process

The change management process helps to:

- Reduce the length and depth of the performance dip
- Improve the degree and rate of adoption of the change
- Support people as they move from adopting the change to full implementation of the change and their new way of doing work

9.5.1 ADKAR® Model

Organizational change starts with managing change at an individual level. The Prosci ADKAR® Model is one of the change management tools BC Hydro has adopted due to its simplicity and common use among change management professionals. Each letter in ADKAR® stands for one of the stages that people move through and build on to adopt change:

- Awareness of the need to change
- Desire to participate and support the change
- Knowledge of how to change
- Ability to implement the change on a day-to-day basis
- Reinforcement to sustain and keep the change in place

ADKAR® helps change leaders structure activities in a way that make sense to people, in a well-structured manner helps them to make an internal transition and ultimately adopt the change.

9.5.2 Change Management Tools and Life Cycle

The Change Management tools, templates, and activities have been organized according to the phases of the BC Hydro project life cycle.

The Integrated Project & Change Management Life Cycle illustrates more about how these two disciplines relate. BC Hydro personnel use the life cycle steps shown in Figure 11 as a guide when planning and implementing projects. More details are available in Table 7 and at this link.

Figure 11: BCH Project Management Phases and Related Deliverables/Activities

Table 7: Change Management Life Cycle Activities

Stages	Initiation	Identification	Definition	Implementation	Transition / Sustainment
Project Management Activities	• Document Business Case • Conduct Feasibility Studies • Appoint Project Team Members • Determine Steering Committee & Governance structure	• Create Detailed Plan & Estimates for Project • Develop Benefits Realization Schedule • Gather Business & Technical Requirements • Define Project in Detail including Deliverables	• Finalize “to-be” processes & IT architecture (as required) • Control Project Delivery, Scope, Costs, Quality, Risks, Issues • Confirm Business Requirements are Achieved • Build IT system (as required)	• Execute Tasks Related to Project Deliverables • Test system, processes & procedures • Deliver Asset to Business	• Transition the Asset to Support • Evaluate Performance Against Targets & Determine Benefits & Process Metrics • Document Closure Report

Stages	Initiation	Identification	Definition	Implementation	Transition / Sustainment
Change Management Activities	• High Level Stakeholder Impacts • Communication & Engagement Strategy • Create Initial Project Summary to build a common understanding of scope, risks, benefits, milestones & resource requirements.	• Stakeholder Impact Assessment • Change Strategy • Develop Communication & Engagement Plan • Analysis of Current & “to-be” Processes & Metrics • Detailed Impact Assessment including Training Needs • Engage Impacted Stakeholders • Ensure Alignment with Sponsors	• Training Development & Delivery Plan • Detailed Implementation Plan (including Change Leadership, Engagement & Sustainment) • Pilot/Test Processes & Procedures as required • Gain all necessary approvals before implementing	• Mobilize Organization (Change Leadership) • Deliver Training • Monitor implementation	• Transition to Sustainment Organization(s) • Track Benefits Realization • Take Corrective Actions to Reinforce Change & Meet Performance Requirements • Update Training as required • Share Lessons Learned
All Phases	• Project Status Reporting • Communication – Craft & Deliver Communications Relevant to Stage • Stakeholder Engagement / Management Activities • Maintain Change Management Risks, Issues & Questions Tracker				
CM Tools and Templates	• Initial Project Summary • Change Management Governance Framework	• Change Management Strategy • Communications Plan • Stakeholder Engagement Plan • Risks, Issues & Questions Tracker • Sponsorship Roadmap	• Training Needs Assessment • Training Plan • Change Implementation Plan • Communications Schedule & Tracker • Stakeholder Engagement Schedule & Tracker	• Training Delivery Schedule & Tracker • Change Leadership Program	• Lessons Learned • Change / Adoption Assessment • Sustainment Organization(s) sign off

10.0 Performance, Benchmarking, and Audits

T&D AIM sets overall performance targets at the asset management system level, based on the corporate risk model. Indicators are developed to help track the reliability of assets and asset classes, as well as project-based indicators for business group performance within AIM.

10.1 Performance Monitoring

T&D AIM has developed a performance management plan (*AIM System & Business Performance Management*) that documents key performance indicators, and the processes of data collection, monitoring, analysis, and reporting of performance data for AIM, including Field & Grid Operations. The plan translates AIM asset objectives into performance measures of system and business performance.

Performance measures support BC Hydro's corporate priorities, and can be tracked to gauge success in implementing BC Hydro's vision and strategy. Analysis of the performance results facilitates continuous improvement and optimization.

Key inputs to the performance management plan include:

- Industry benchmarking
- Corporate goals, core values, and targets
- Objectives and measures within the various T&D groups
- Interviews and discussions with key managers
- Reference documents

10.1.1 Performance Management Methodology

BC Hydro's strategic vision is translated into discrete performance goals and tied to specific metrics based on recurring activities. These metrics, or key performance indicators (KPIs), measure progress towards strategic goals and more specifically, to T&D AIM's asset management objectives. The metrics aid in decision-making to ensure that objectives are achieved more effectively and efficiently. KPI values are collected and reported to stakeholders on a regular basis.

The methodology for AIM performance management as shown in Figure 12 uses:

- **Balanced scorecard approach**: A tool that lists a selected number of performance metrics or objectives, along with their frequency of measurement, actual performance in the previous fiscal year, and target performance for the current or next fiscal year.
- **Plan-Do-Check-Act performance management model**: An iterative four-step method used to manage, control, and continuously improve a process or service.
- **Life cycle asset management framework:** The basis for planning and managing T&D assets across the system, which balances risk, performance, and optimized life-cycle cost.

This methodology leads to continuous improvement through performance monitoring and internal and external benchmarking. Where opportunities for improvement are identified, root-cause analysis is conducted, measurable improvement targets are set where appropriate, and improvements are implemented and monitored.

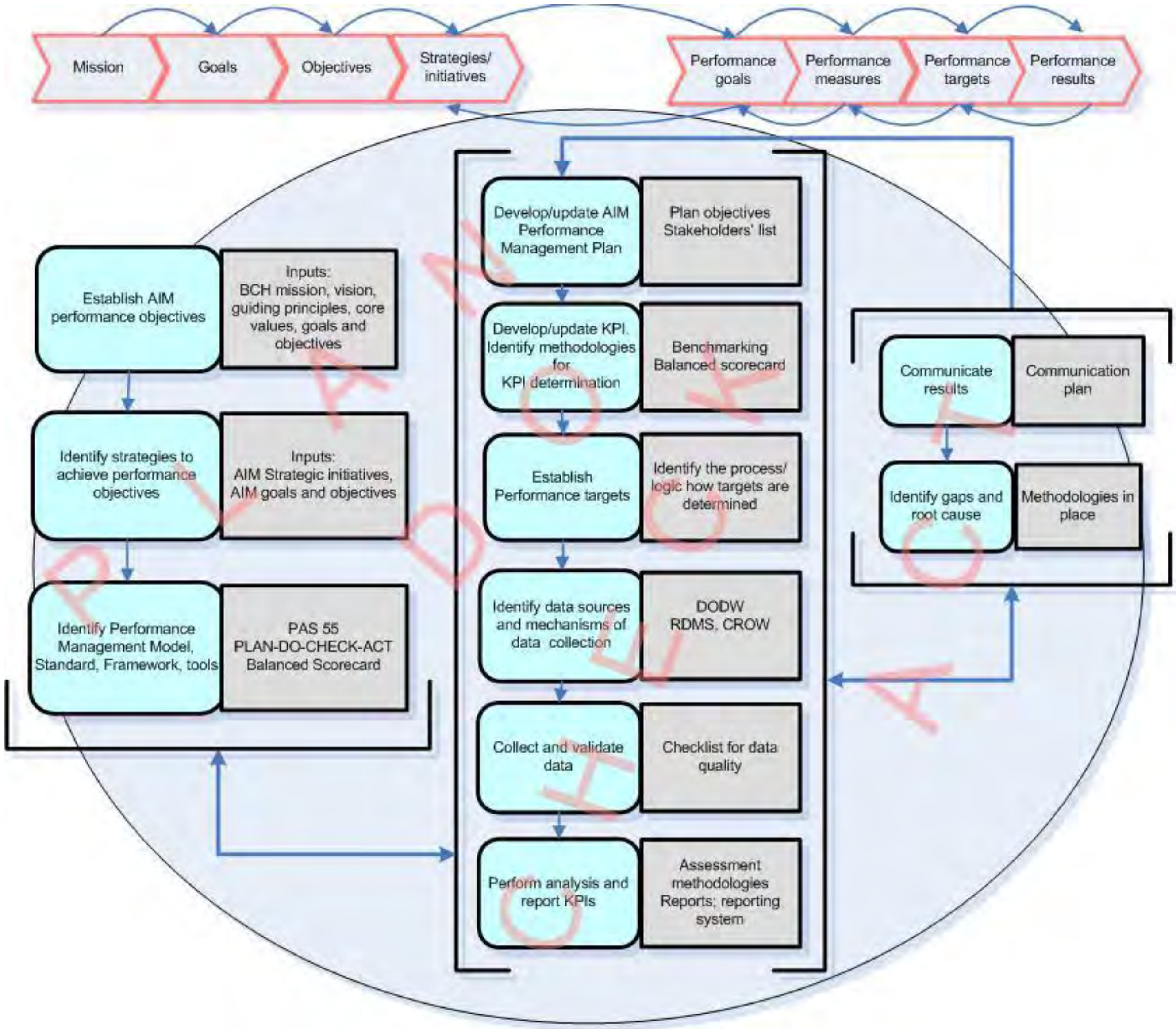


Figure 12: T&D AIM's Performance Management Process

10.1.2 Key Performance Indicators (KPIs)

The key performance indicators (KPIs) used by T&D AIM for asset management are divided into four categories of metrics, as shown in Figure 13:

- **Primary**: Results metrics that support the overall priorities of the organization.
- **Secondary**: Results metrics that support the primary metrics at a sub-level (department, area, group, etc.).
- **Process/Activity**: Diagnostic metrics that highlight why (root cause) the current level of performance is being achieved.
- **Improvement**: Diagnostic metrics that measure the progress of improvement projects or efforts.

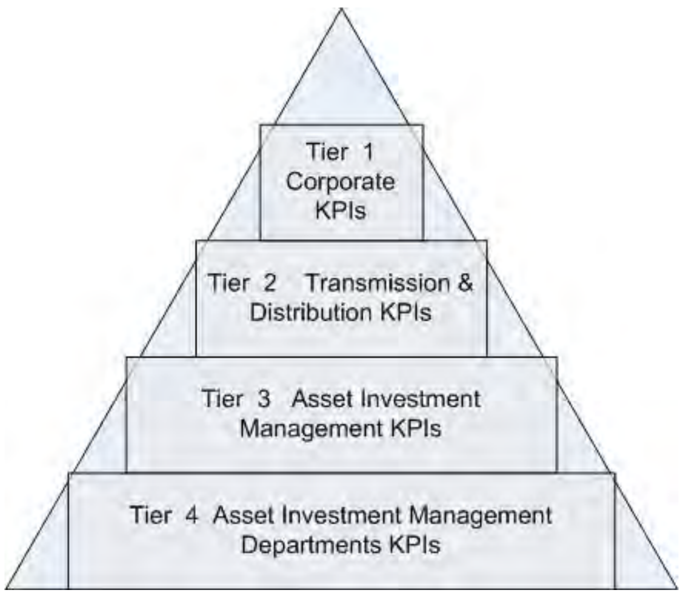


Figure 13: Four-tier Key Performance Indicator (KPI) System

10.1.3 Reporting and Action

Efficient performance management relies on reporting mechanisms to distribute information. Periodic reporting depends on the availability of new data and the criticality of the performance being measured, while exception reporting deals with deviations from expectations based on trigger points.

For each KPI, targets (or baselines) are established that define the expected performance level for whatever is being measured, and triggers are established for each target/baseline. As long as the actual values are within the tolerance range, no action is required. If the KPI value falls above or below the tolerance range, the trigger is reached and action is required to address the variance:

- If the variance is better than the expected tolerance, “process action” is taken to determine the variance cause. A root cause analysis is done for these process action variances to determine if new best practices or processes are occurring that should be captured for future dissemination within BC Hydro.
- If the variance is worse than the expected tolerance, “corrective action” is taken to determine the root cause of the variance and develop a plan for performance improvement.

10.2 System Level Performance Objectives

At the system level, T&D AIM recommends overall performance targets, based on the corporate risk model. T&D management establishes the threshold for risk and may change weightings as appropriate. Performance objectives drive Capital and O&M Plans, and include:

- Meeting load requirements
- Optimizing life cycle investment to meet reliability and power quality measures
- Maintaining an acceptable level of risk
- Aligning with corporate business goals

T&D AIM measures, audits, and reports on compliance with performance objectives against some of the following targets—not all are specific to AIM. The metrics across all regions and business areas are rolled up and reported on the T&D Monthly Performance Dashboard, which provides the ability to spot trends and whether performance is meeting or failing to meet specified targets.

Safety:

- Number of serious injuries in last 12 months
- Lost time injury frequency rate
- Serious motor vehicle incident (MVI) rate
- Crew observations by managers per month (SWOP reports, as tracked by Field & Grid Operations)
- Near miss reports filed per month (as tracked by FGO)

Reliability:

- Average number of outages (SAIFI)
- Average outage duration index (CAIDI)
- Customers with four or more outages (CEMI-4)
- Distribution trouble response time
- Personnel incidents (forced outages/system equipment damage)

Operational excellence:

- Actual versus planned spending for Growth Capital and Sustain Capital (gross), SMI capital (Smart Metering & Infrastructure program), total capital, and net O&M
- Annualized average amount of overtime compared to target levels for Transmission Electrical, Distribution Electrical, Cable Splicers, Stations Electrical, and Construction Services

Customer relationships:

- Trouble – estimated time of restoration (ETR) compared to target
- Electrical Service Coordination Centre (ESCC) call waiting performance

Workforce performance and sustainability (as measured by T&D Human Resources):

- Actual headcount
- Budgeted headcount
- Number of vacancies

Innovation and technology:

- Performance across the eight regions in B.C. on current innovation and technology initiatives, such as the number of meters installed to date compared to targets

10.3 Asset Level Performance Objectives

At the asset level, T&D AIM establishes objectives for the performance of assets according to similar criteria as for the system level, above (safety, reliability, operational excellence, performance, etc.) For example, a 30-year useful life may be projected for a transformer based on planned capital spending and expected reliability over the asset's life cycle. Each asset has its own measurement methods and performance indicators.

10.4 Benchmarking

Benchmarking is a systematic and continuous measurement process that identifies major performance improvement opportunities by comparing key results and work activities with industry peers. Benchmarking provides a quality performance target to shoot for, with the aim of achieving and sustaining best-in-class performance by making improvements and closing gaps. The benefits of benchmarking for BC Hydro include improved ability to:

- Identify industry best practices
- Meet customer requirements
- Establish effective goals and objectives
- Develop true productivity measures
- Become and remain competitive with other utilities

BC Hydro does benchmarking at both an asset level and a system level, comparing the performance of the asset management system and specific asset classes to industry peers. The T&D Monthly Performance Dashboard described above shows the key performance targets for the asset management system. Asset class strategies cover specific performance targets for each asset class.

On the transmission side, compiled industry data is obtained from agencies that gather measurements from other utilities, including the IEEE (Institute of Electrical and Electronics Engineers) and others.

On the distribution side, BC Hydro participates in leading North American benchmarking forums such as PA Consulting, First Quartile Consulting and EUCG to continually provide feedback on KPIs relevant to the industry. In addition, BC Hydro compares its performance annually against a composite of utilities in the CEA (Canadian Electricity Association) through its Committee on Performance Excellence (COPE) and the Service Continuity Committee programs.

BC Hydro's benchmarking process follows these general steps:

1. **Establish benchmarking process**: Define reasons for benchmarking, understand BC Hydro processes and benchmarking activities, develop study parameters, clarify rules of conduct, use public information.
2. **Identify the need**: Clarify the specific need, define and assess the issue.
3. **Plan the study**: Decide what to benchmark, define the project, obtain approval, launch project.
4. **Collect data**: Define measurements and develop an analysis plan, choose and refine data gathering methods, solicit input from appropriate sources.
5. **Analyze data**: Synthesize data, standardize performance indicators, compare performance against partners, identify gaps, identify characteristics of best performers, define key performance variables associated with best practices.
6. **Implement changes**: Develop recommendations, communicate results, set goals, plan and implement changes, track progress, recalibrate benchmarking study.

10.5 Quality Assurance and Audit

BC Hydro's Audit Services group ensures compliance with regulatory requirements, and carries out internal audits of BC Hydro and its subsidiaries. The purpose is to provide assurance to regulators and stakeholders that appropriate controls and effective risk management processes are in place to support and achieve the company's business objectives. Their primary role includes:

- Developing a comprehensive annual Audit Plan outlining the services to be provided to the Board of Directors and management of BC Hydro and its subsidiaries
- Assessing whether potential risks are appropriately identified and managed
- Reviewing the adequacy of controls and compliance with policies and procedures
- Assessing whether financial and managerial reporting is accurate, reliable, and timely
- Conducting post-audit follow-ups to ensure committed management action plans are completed
- Carrying out ad hoc appraisals, investigations, or reviews requested by management, BC Hydro Board of Directors, the Code of Conduct Advisor, and the Ethics Officer

BC Hydro's Audit Reporting and Monitoring Procedure defines internal audit planning, reporting, and monitoring procedures, and the responsibility of management for responding and implementing action plans.

The internal audit process begins with the annual development of an Audit Plan (current one here), which serves as a guideline for conducting audits in the coming year. The timing of each audit is discussed with the auditees and Senior Management in the Business Group. The typical audit process covers planning, field work, monitoring, and post-audit reporting, as shown in Figure 14.

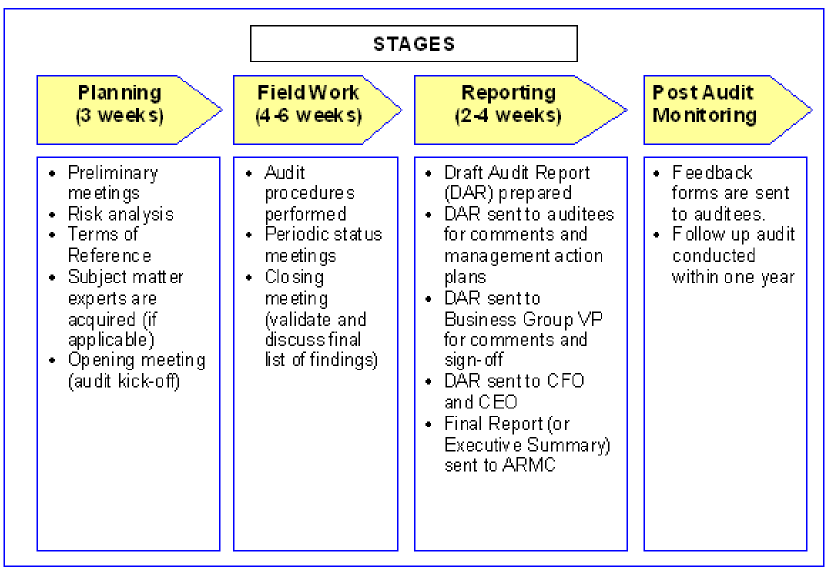


Figure 14: Typical Internal Audit Process by Audit Services

Audit Services uses a three-tiered approach for its audit framework, with a comprehensive program including risk-based, cyclical, and compliance audits. Each component is reviewed and updated on a regular basis, based on information received from risk assessments, benchmarking, and other monitoring and reporting activities. This integrated approach provides support for an effective control environment at BC Hydro.

At the asset level, quality assurance relates relates to the criticality of receiving quality data, adherence to standards and budgets, and an overarching philosophy of ensuring lowest total lifecycle costs and maximum reliability.

11.0 Functional Level Strategies and Standards

This section describes the strategies and standards that are specific to the asset or asset class level. For definitions, see page 16. High-level policies, strategies, objectives, and plans required to implement and manage the asset management framework are described in earlier parts of this document.

Strategies for many of the T&D assets are described in detail in BC Hydro's most recent *T&D Asset Management Strategy*, which is updated and published each fall. Each individual asset class strategy includes detailed information on the asset, including but not limited to:

- Description of the asset
- The asset's contribution to the system and BC Hydro's corporate priorities
- Performance objectives and standards
- Asset count, condition, and performance
- Asset management strategies for each stage of the asset life cycle
- Investments required to sustain the assets and maintain system performance

Below are brief descriptions of strategies and standards for various portfolios. Development is ongoing based on priority.

11.1 Transmission System: Asset Class Strategies

Transmission lines (circuits) are made up of a variety of different assets that work together to move power across the grid and deliver safe, reliable, and cost-effective electricity. Included in this asset portfolio are all 600 of BC Hydro's transmission circuits and their associated components.

11.2 Distribution System: Asset Class Strategies

The distribution system delivers electricity from the substation fence to the customer's point of delivery. Included in this asset portfolio are the overhead and distribution underground systems.

In addition, the Distribution Automation Strategy documents the application of intelligent electronic devices and system applications to enable BC Hydro to monitor distribution equipment remotely, gather system and equipment information, and take appropriate control actions to respond to system abnormalities, adjust to dynamic loads, or meet optimization objectives. Distribution automation is an integral component of the BC Hydro Smart Grid concept.

11.3 Stations: Asset Class Strategies

The stations portfolio includes many different assets, ranging from power transformers and circuit breakers to auxiliary equipment such as batteries and fire suppression systems. All of the substation assets are integrated into a single system so that an integrated approach to planning and maintenance can be applied to improve efficiency and ensure good decisions at the right time.

For the system to work effectively, all of the individual assets in a station are managed together via asset management strategies. The strategies consider the condition and performance of each asset, its interaction with other system assets, and how to maximize performance and value over time as the station ages and more assets need to be replaced. The strategies look at all the work required at a station, and group that work together for efficiency.

11.4 P&C-Telecom: Asset Class Strategies

The Protection Control (P&C) and Telecom Strategy and Standards group manages all Protection, Control, SCADA, and Telecommunications assets located in substations and microwave repeater sites around the province. Asset classes in this portfolio include fibre optic equipment, microwave equipment, power line carrier equipment, and a wide variety of protection and control assets.

11.5 Rights-of Way and Vegetation Management: Asset Class Strategies and Standards

Asset class strategies for rights-of-way and vegetation management include:

- Rights-of-ways and land (statutory ROW, easements, fee-owned and leased lands)
- Access infrastructure (roads, bridges, gates, signage, docks, trails, helipads, etc.)
- ROW vegetation maintenance (to protect unobstructed air space around power lines)
- Hazard trees (removal of defective trees that may fall into the lines)
- Facilities vegetation maintenance (to protect workers and equipment at substations, switchyards, and microwave sites)

Future planned strategies for ROWs may include IT data maintenance and forest health.

Vegetation management is the largest component of the land-based asset programs. A safe and unobstructed air space around power lines is an asset that is critical to the ongoing operation of the electrical system, so it is subject to NERC reliability standards. The vegetation management program prevents trees from growing into the lines, and maintains a stable, low-growing state on the ROW. Another program maintains the gravel layer and ground grid in facilities to protect workers and avoid vegetation growth into electrical equipment. All vegetation management work is administered by Capital Infrastructure Project Delivery and carried out by third-party contractors. Since vegetation management is highly visible, BC Hydro takes great care to balance fiscal, social, and environmental interests, including facilitating safe compatible use activities on ROWs, such as ranching and recreation.

Standards for ROW maintenance are continuously being revised and streamlined (e.g., to combine previously separate T&D standards where feasible). The purpose of the standards is to address and implement the strategies. Some standards are required in order to meet NERC requirements (such as those relating to mandatory reliability standards), while others are guidelines or provide information. Some standards also relate to the joint ownership agreement with TELUS.

11.6 Non-integrated Areas (NIA) Asset Management Strategies

As of 2012, AIM provides all the asset management strategies for NIA substation assets. This ensures that NIA strategies are aligned to the broader substation standards, as well as end-of-life replacement and upgrade criteria for investment decisions.

NIA is the asset manager and makes investment decisions for NIA generation facilities and properties and other major asset classes, for which NIA management is developing an NIA asset management strategy and a 10-year Capital Plan. Currently, it has a diesel fleet strategy for its 52 mobile and stationary diesel generating sets, which are deployed at its 11 stations around the province. Based on age and condition, units are designated for retirement, and overall fleet capacity and flexibility are considered when purchasing and allocating new generating sets. Fleet optimization allows for meeting N-1 criteria and load growth across the NIA systems, to ensure that BC Hydro’s reliability objectives are met. (The N-1 criterion expresses the ability of the system to lose a linkage without causing a failure elsewhere.)

Other asset categories reviewed by NIA Engineering for asset management decisions include:

- Station switchgear/protection and control equipment
- PML metering
- Communications
- Ground grids
- Powerhouses and buildings

11.7 Third Party Service and Joint Use Agreements

Third party service agreements refer to communication lease agreements with third party carriers such as cellular or communications companies. The main strategies are to leverage existing and new assets in a way that reduces expenses for ratepayers without subsidization from BC Hydro, and to facilitate economic development to enable deployment of services.

BC Hydro also has a joint ownership and use agreement with a third party communication carrier (TELUS) that defines capital and operating cost sharing on a large percentage of the distribution pole infrastructure. This agreement was signed in 1971 and covers approximately 80% of the total wood distribution pole population in BC Hydro's service area. The agreement also serves to minimize the footprint and environmental impact of the infrastructure by minimizing redundancy in pole lines. The ongoing strategy with TELUS is to continue to manage the assets in a way that meets the current and future business needs of both parties at the lowest lifecycle cost.

11.8 Interconnections Asset Strategies

The Interconnection and Shared Assets group (I&SA) helps facilitate and implement government policy and the *Clean Energy Act*, according to the tariffs (See Section 3.5.2, Tariffs), by providing access to IPP generation without any ratepayer subsidies, without impacting safety, and without negatively impacting reliability.

I&SA is responsible for reviewing, aligning, recommending, and managing interconnection tariffs for all customers requesting connection to the BC Hydro system. In addition to developing policies, the group manages the interconnection queues, processes, and agreements that ensure customer connections to the system. They also manage the initial and ongoing customer life cycle commitments while ensuring compliance with all interconnection agreement obligations and system technical requirements.

11.9 Customer Connections Asset Strategies and Standards

Transmission connections can take significant planning, design, and construction time (between 6 months to 7 years). When BC Hydro receives a transmission connection request from a load customer or generator customer, a conceptual review, system impact study, and facilities study are completed. This process determines:

- System capacity
- Connection methods and options
- Potential system reinforcements
- Customer requirements
- Facilities required and costs
- Timelines
- Detailed technical requirements
- Project plan and cost estimates

For a generator customer, an Electrical Purchase Agreement (EPA) is usually signed after the system impact study is completed. For a load customer, an Electrical Supply Agreement is usually signed just prior to energization. Once a Facilities Agreement (load customer) or Standard Generator Interconnection Agreement (generator) is executed, the customer submits required documentation and provides a financial commitment (direct capital contributions and security as defined in the tariffs). The interconnection infrastructure is then installed.

Customers may connect to the distribution system per the terms and conditions in BC Hydro's Electric Tariff. At least one service connection to a property will be provided at the customer's cost. If new facilities must be constructed to allow a service connection, the extension policy applies. A designer will design the facilities and calculate the extension fee to be paid by the customer according to the tariff. For non-extension requests (e.g., relocations) the customer will be charged full cost, less any allowances such as asset depreciation credits and joint-use credits.

Table 8 lists and links to key standards for transmission and distribution interconnections. AIM is accountable and responsible for developing and maintaining the standards.

Table 8: Customer Connection Standards

Customer Connection Standards	Description
Transmission interconnections:	
• Transmission Standard Generator Interconnection Requirements (SGIP)	Procedures for interconnection to the transmission system. The SGIP is a structured procedure with defined "steps" and requirements in each step that IPPs must fully follow.
• Guide and Requirements for Service at 69,000 to 287,000 Volts	Requirements and guide for interconnecting load customers to the transmission system.
• 60 kV to 500 kV Technical Interconnection Requirements For Power Generators	General technical requirements for interconnection customers to connect to the transmission system.
Distributed Generation Technical Interconnections Requirements 100KW and Below	Requirements and guide to distributed generator interconnections from 100kW and below.
Distribution load interconnections:	
• New Residential Connections	Guide for residential connections – new construction or renovations
• New Industrial Connections	Guide for multi-residential, commercial and industrial projects.
• Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV	Primary service guide.
Distribution Instructions	Required BC Hydro policies and procedures for functions associated with distribution.

11.10 Revenue Meters Asset Standards

The management and quality control of revenue electric meters, instrument transformers, and auxiliary equipment follows various metering standards, requirements, and guides, as listed here. Under the *Electricity & Gas Inspection Act,* the RMSM group manages metering assets and implements a Meter Accreditation Program. Under this program, BC Hydro must re-verify meter accuracy at prescribed intervals, and develop and implement a Quality Management System (QMS).

Measurement Canada grants accreditation to verify/re-verify meters on their behalf, and BC Hydro achieved accreditation in 1992. The scope of the accreditation program includes verification, re-verification, and compliance sampling of revenue metering devices used by BC Hydro. Accreditation allows BC Hydro to meet its regulatory obligations, maximize efficiency, and minimize failed sample groups of meters.

The following RACI chart (Table 9) describes standards related to revenue metering and responsibilities for them.

Legend:

R Responsible
A Accountable
C Consultative/collaborative role
I Needs to be informed

Table 9: RACI Chart: Revenue Metering Standards

Revenue Metering Standards	Description	RMSM	D. Eng & Stds.	FGO	Safety
Planning	Standards that provide the overarching architecture, topology, strategy, asset technology, and performance criteria	A&R	C	C	
Engineering & Design	Standards that outline how the asset/system components are engineered, designed, and constructed	A&R	C	C	C (as req'd)
Technical specification	Specifications of equipment, materials, and construction that meet the performance criteria and asset strategies	A&R	C	C	C (as req'd)
Work Methods	Prepare work methods procedures for the safe maintenance and operation of the T&D assets	C	C	C	A&R
Commissioning	Standards for the commissioning process, including testing, commissioning, and record keeping	A&R	C	C	C (as req'd)
Maintenance	Standards that outline the frequency of inspection/maintenance and specify maintenance/repair for existing assets	A&R (C for HV Instrument transformers)	C	C	C (as req'd)

12.0 Step-by-Step Asset Management Processes

This section describes how T&D AIM carries out its asset management work under the AMF.

Various groups within AIM are responsible for different aspects and they work in coordination to ensure an effective and cohesive overall process. (See Section 4.4) Figure 15 is a generic diagram from the 2008 PAS 55-1 specification that shows how the basic asset management processes (green box) relate to other aspects of the asset management system.

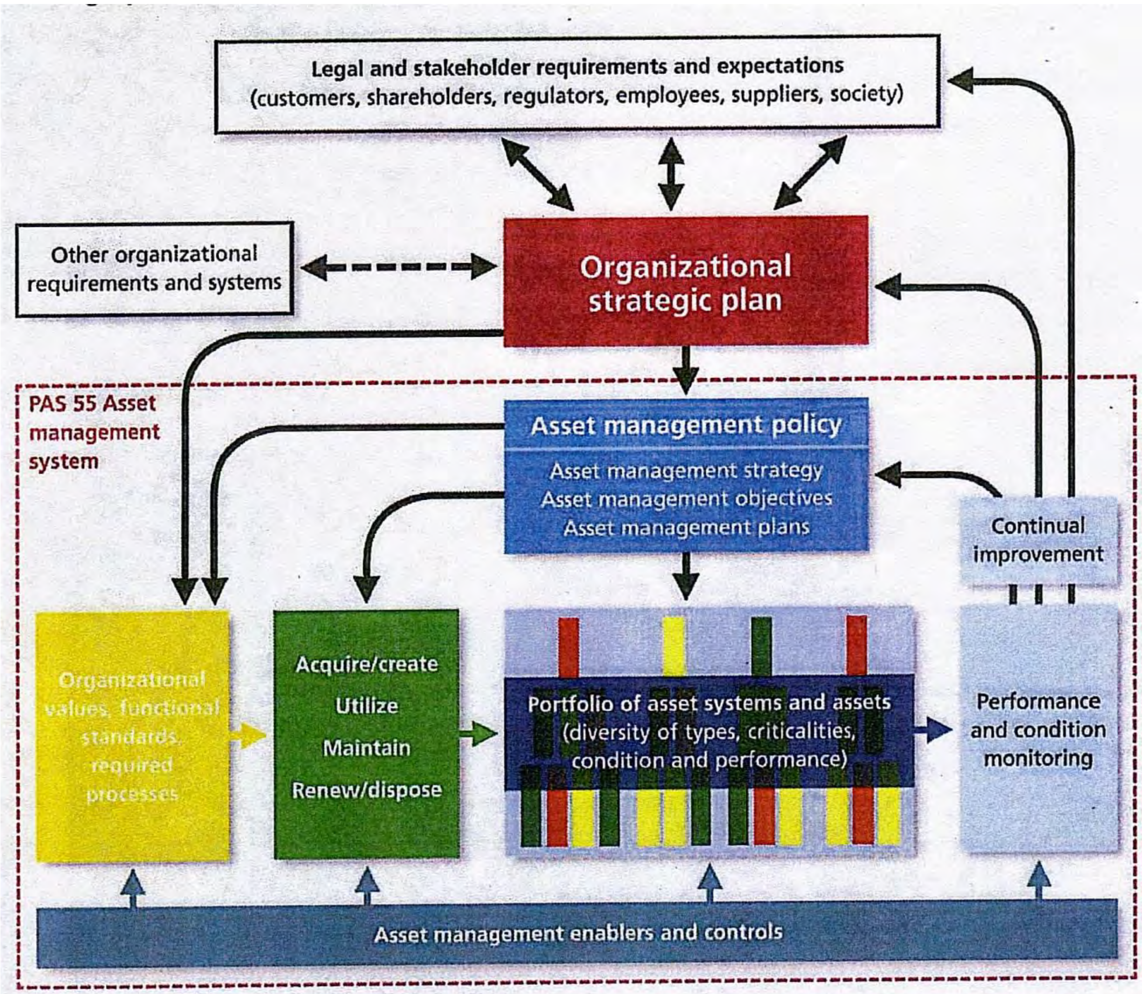


Figure 15: Overview of the Asset Management System

(Source: PAS 55-1:2008, page viii)

12.1 Asset Management Life Cycle

Effective implementation of asset management requires a disciplined approach to ensure that T&D AIM maximizes value and fulfills priorities by managing assets over their whole life cycle. This approach involves determining:

- Asset base requirements – what to acquire or build
- Life cycle management needs – how to best operate and maintain assets
- End of life cycle needs — what are optimal renewal, decommissioning, and disposal options

Optimized asset life cycle management has several benefits:

- Systematically reduces risks
- Improves control, performance, and service delivery for T&D operations
- Enhances customer satisfaction
- Improves safety and environmental performance

The high-level actions defined in the AMF generally require specific inputs and occur at different times of a typical asset life cycle. While there is some overlap in the required inputs, Figure 16 shows the typical touch points for governance and corporate (policy) level activities. At every level, these policy inputs must be approved to ensure an effective implementation and follow through on strategy development, execution of plans, and timely monitoring of outcomes.

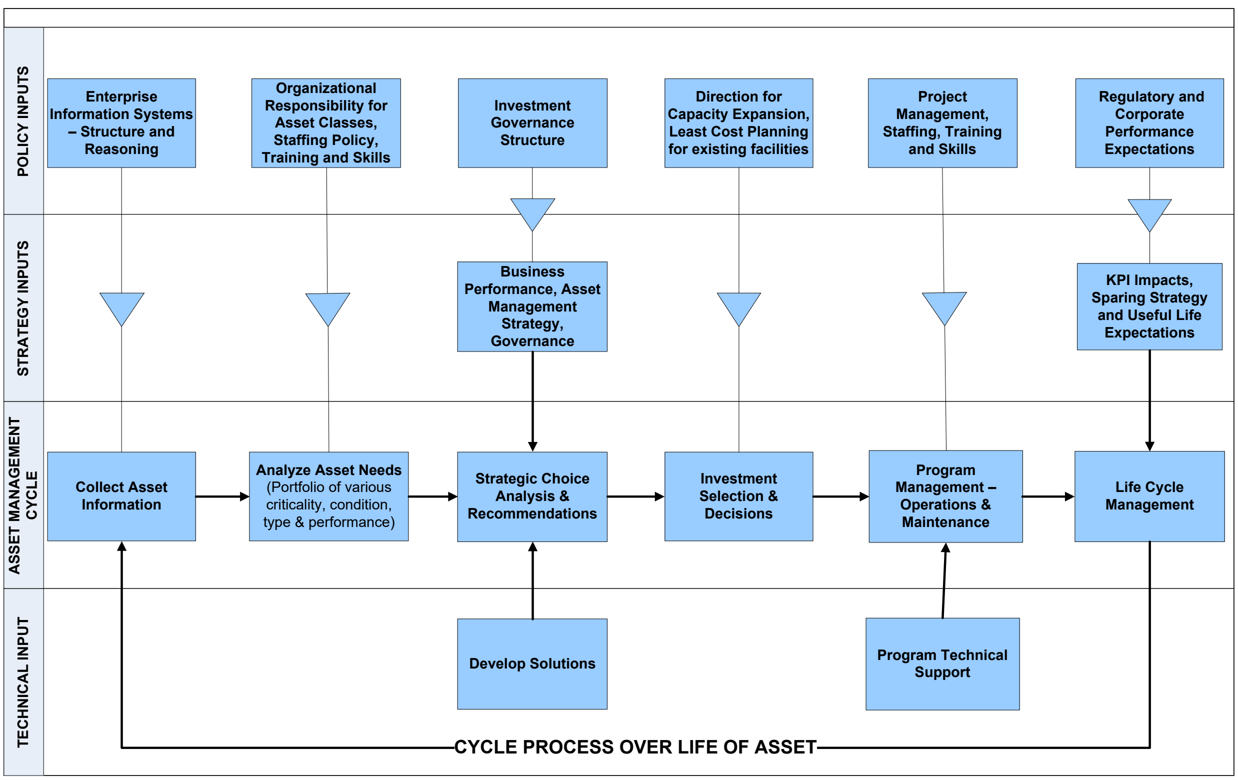


Figure 16: Policy Interaction and Strategy Implications Along a Typical Asset Management Cycle

(Source: Gilpin-Jackson, A. (2010). *Strategic Asset Management for Physical Infrastructure: Run, Repair, Refurbish, Replace*. Masters Dissertation, Segal Business School, Simon Fraser University, B.C.)

12.2 Fundamental Steps in Asset Management

Although complex, the asset management process can be distilled down to these fundamental steps:

1. **Planning**: T&D produces a Capital Plan for growth and sustaining investments, and an O&M Plan for operations and maintenance. These plans outline the expected needs and budgets for future asset growth and operations, and allow T&D to plan investments and needs in advance.
2. **Trigger**: An asset need arises related to reliability, safety, environment, opportunities, load growth, new IPPs, new regulatory requirements, customer requests or needs, etc.
3. **Risk management, asset optimization**: The need is evaluated and prioritized based on risk and asset optimization.
4. **Consultation, assessment**: A solution is developed and internal and external consultations are carried out as required. If the solution involves a capital investment, a total life cycle analysis and risk assessment is done.
5. **Implement and manage work**: After approval, the recommended solution is implemented, which may involve budgeting, more consultation, procurement, design/build work, contractor recruitment, in-service installation, repair, etc.
6. **Evaluation, performance monitoring, benchmarking, audits**: The installation or work is evaluated to see if it satisfies the original need. If not, or if it has created new needs, the work cycle begins again. In addition, performance of assets and asset systems are routinely checked against performance indicators and benchmarked, and quality assurance audits are carried out.

Results of the asset management work and performance drive the capital planning and O&M planning process, making asset management an iterative process – a constantly repeated cycle.

All decisions are driven by BC Hydro's corporate mission, vision, values, and priorities, including the 2010 *Clean Energy Act* and 2007 Energy Plan. Further, decision-making and work are based on corporate and T&D policies, objectives, strategies, plans, and standards.

12.3 Planning Asset Investments

Planning for assets that need to be purchased or replaced is the first stage. Various groups within T&D AIM carry out the required activities. Specific responsibilities are listed below.

- Identify and evaluate asset or system needs.
- Conduct studies and develop solutions.
- Optimize asset investments and resources.
- Conduct engineering reviews and develop Distribution standards.
- Complete Distribution design work.
- Manage meter exchange work (customer service).
- Undertake project and contract management.
- Execute Distribution, Transmission, and Construction Services work.
- Manage execution of work (administrative work).
- Manage Customer Connect projects.
- Manage Customer Build projects.
- Manage Metering operations.
- Operate the electrical system.
- Operate and control Smart Metering Network.
- Operate and control the Telecom system.
- Perform and track emergent work (HRC).
- Manage T&D Operations Performance

References

BC Hydro. *AIM System & Business Performance Management* (for T&D and AIM). V.4, March 2011.

BC Hydro. *Asset Health Index Report*. (2016 Q4).

BC Hydro. *BC Hydro 101: Presentation to the OAG.* July 2016

BC Hydro. *A Practical Guide to Benchmarking*. Asset Risk & Performance Management, T&D. December 2010.

BC Hydro. *Smart about power in all we do: Our plan to guide our work*. September 2015.

BC Hydro. *T&D Asset Management Strategy*. December 2016.

BC Hydro. *Technology Plan Executive Summary*, 2015

British Standards Institute. *ISO 55000:2014, Asset management -- Overview, principles and terminology*.

British Standards Institute. PAS 55-1:2008 – *Asset Management. Part 1: Specification for the optimized management of physical assets*. September 2008.

British Standards Institute. PAS 55-2:2008 – *Asset Management. Part 2: Guidelines for the application of PAS 55-1.* September 2008.

Gilpin-Jackson, A. *Strategic Asset Management for Physical Infrastructure: Run, Repair, Refurbish, Replace*. Masters Dissertation, Segal Business School, Simon Fraser University, B.C. 2010.

Front cover photo: Technician working on an arcing horn.

Change Log

Since the original issue of the T&D Asset Management Framework document in 2012, the following changes have been made. (The list does not include minor typographical or wording changes, formatting changes, or changes to heading or figure/table numbering.)

Date	Section	From	Change
Jan 2014	2.2.2, T&D Life Cycle Asset Management Principles	Larry Haffner	Rewritten and new info added.
Feb 2014	3.2, BC Hydro's Asset Management Policy	Larry Haffner	New section added: a complete copy of BC Hydro's new Asset Management Policy.
Feb 2014	3.3.1, Clean Energy Act	Larry Haffner	Info added on Integrated Resource Plan to be produced under the Clean Energy Act.
Feb 2014	3.5.4, Measurement Canada	Susan Tang	Updated: Description of RMSM and role of Measurement Canada.
Feb 2014	4.1, T&D Vision and Mission	Larry Haffner	Added: BC Hydro's Vision and Mission.
Feb 2014	4.3, T&D Operating Model	Larry Haffner	T&D Operating Model diagram replaced with updated version.
Feb 2014	4.4.1, Asset Investment Management	Larry Haffner	Tables describing the roles of AIM and other BC Hydro groups completely re-written and re-organized (split into 3 tables)
Feb 2014	5.5, Asset Health Index	Thomas Ta	Section completely rewritten and updated to reflect the 2013 Asset Health Index Report.
Feb 2014	9.0, Communications and Consultation 9.1, Communications Plan	Larry Haffner	Revised title. New section describing T&D's Communications Plan.
Feb 2014	11.7, Third Party Service and Joint Use Agreements: Asset Class Strategies	Mark Dayton	New paragraph added on TELUS joint use agreement.
Feb 2014	11.12, Functional Asset Plans	Joyce Arthur	New paragraph added on "Individual Asset Class Strategies."
March 17, 2014	Front/back matter	Larry Haffner	Change Log added to back, and Revision box removed from beginning.
March 17, 2014	1.4, Updating the Strategy Document	Larry Haffner	New section added on process for updating the document.
April 10, 2014	5.5, Asset Health Index	Katherine Louman-gardiner	Table 4: Asset Health Index Ratings, replaced with new version.
April 24, 2014	Section 5.5, T&D Growth Strategies	Larry Haffner	Sections added to describe several planning manuals: System Transmission Studies Guide, Engineering Planning Guide, and Distribution Planning Practice Manual.

Date	Section	From	Change
September 2014	4.4, Overall Roles of BC Hydro Functional Areas	Larry Haffner	Updating roles tables according to new T&D org charts (March 2014).
Oct/Nov 2014	All	Larry Haffner	Overall update of Framework.
Sept-Nov 2015	All	Larry Haffner	Overall update of Framework, including new re-org reflected in Section 4.4 (“Roles” tables).
June 2016	9.5, Change Management	Larry Haffner	Rewritten and updated
June 2016	3.1, BCH Mission etc.	Larry Haffner	Updated to reflect the new values and priorities
Nov 2016	All	Larry Haffner	Overall update of Framework, including re-org changes in Section 4.4 (“Roles” tables)
Nov 2016	5.6, Technology and Future Needs	Larry Haffner	Rewritten
Nov 2016	8.0, Risk Management	Larry Haffner	Rewritten
Nov 2016	10.5, Quality Assurance and Audit	Larry Haffner	Rewritten
Nov 2016	11.0, Functional Level Strategies and Standards	Larry Haffner	Rewritten
Nov 2016	12.0, Step-by-Step AM Processes	Larry Haffner	Updated and simplified; process flowcharts removed as they are no longer available.

COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 3

T&D Wildfire Hazard Strategy

4.1.4 Wildfire Risk Management

Asset Description	Wildfires are fires that occur within 300m of a forested or rangeland area beyond the jurisdiction of a municipal fire department to respond. They are typically fought when they occur in populated interface areas or monitored and allowed to naturally burn by the Wildfire Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. British Columbia experiences roughly 2000 wildfires each year. In an average year wildfires consume approximately 100,000 ha of land, but in both 2017and 2018, new records were set for area burned with over 1.2M to 1.3M ha affected in the past two years, respectively. Most fires (54%) are started by people and the rest are attributed to lightning strikes. Wildfires can occur at any time of the year but most occur within an April 1 to November 1 timeframe. Wildfires can pose risks to the BC Hydro system, notably the transmission and distribution lines, substations, and communications sites situated outside municipal limits, and on occasion our generation facilities. Conversely, our energized electrical system can also pose risks of igniting wildfires and good maintenance is required to ensure this risk is effectively mitigated.
Vision	To protect critical infrastructure (bulk electric grid, transfer substations, microwave sites, and generation facilities) from wildfire damage and minimize customer interruptions by minimizing damage on local or regional supply assets. Minimize the potential for the ignition and spread of wildfires from the electrical system.
Contribution to Organizational Objectives	**Safety:** Protect workers and the public from risks associated with wildfires starting or spreading along rights of way, sites, or facilities managed by BC Hydro. **Reliability and Customer Service:** Minimize the risk of power disruption caused by wildfires damaging infrastructure. **Financial:** Minimize costs of damaged or lost infrastructure caused by wildfires. Reduce liability risks from claims against BC Hydro that wildfires originated or spread from our facilities or rights of way. **Security:** Manage fuel debris and vegetation growth around our facilities and rights of way help ensure the integrity of the power system. In addition, rights of way and associated access are often used by the provincial Wildfire Branch as fuel breaks to protect critical infrastructure and communities from spreading wildfires. **Environmental:** Minimize environmental damage caused by wildfires – this includes habitat destruction to wildlife and vegetation caused by intense wildfires, erosion from loss of vegetation cover, and spread of invasive species following wildfires.
Criticality	Criticality varies with the asset and is defined for transmission and distribution circuits, substations, generating stations and other facilities, as well as for microwave and communications sites. Risk of wildfire to these assets is determined by the probability of wildfire ignition near an asset, depending largely on the vegetation types, climate and local site conditions, and the consequence of damage from a wildfire. Wildfire risk mapping of transmission assets is available in the corporate Geographic Information System using PowerGrid. High criticality for wildfire exists at bulk electric substations, major hydroelectric generating sites, some microwave sites critical to the control of the electrical system, and certain transmission lines – especially the bulk electric grid and radial circuits.
Strategic Issues	To mitigate the risks to the electrical system from wildfire, BC Hydro has a Wildfire Services Agreement in place with the Province of BC. This agreement allows for planning and allocation of firefighting resources provided by the Province in the event of fires that put our transmission, distribution, or generation assets at risk. In return, it avoids damage claims against BC Hydro for fires ignited by the electrical system as long as we performed our maintenance according to industry standards and were not willfully negligent in our duties. The agreement also permits some exemptions to BC Hydro from provisions of the *Wildfire Act* and Regulation where they do

	not fit well with utility activities. BC Hydro is subject to the *Forest Act* and *Wildfire Act,* which have impacts on our business since so much of our infrastructure is within the Provincial Forest and Range area and outside of municipal fire protection zones. The fees paid for the Fire Services Agreement is in proportion to our assets in different fire risk zones. We do have maintenance obligations particularly around vegetation management and fuel debris management to meet the regulations, and BC Hydro must also assess fire risk in all of our maintenance activities to ensure we have appropriate precautions in place if we are doing high risk activities during fire season. Mitigation may include things such as fire watch and provision of fire tools and equipment, including water delivery systems based on work location, fire danger rating when work is taking place, crew size, and maintenance activity. Asset Sustainment works with Corporate Safety – notably Emergency Management and the Fire Marshall to ensure appropriate procedures are in place to mitigate fire risk.
Future Requirements	Since 2000, BC has had three very significant fire years in 2003, 2017 and 2018 where much higher than average fire activity occurred. In 2017 and 2018, we had the two higest record years for area burned by wildfire, exceeding the old 1958 record. With climate change and increased interface from building activity in wildland areas, we expect an increased risk from significant wildfire activity over the next few decades, particularly in the South and Central Interior and southern Vancouver Island, which are often subject to prolonged dry spells each summer.
Regional Issues	Wildfire risks occur across the province but the risk is broken out by the Province into high/medium/low probabilities based on how hot and dry the March-November fire period is in various regions. The risk is highest in the Central and Southern Interior and Southern Vancouver Island, and typically lowest along the Coast especially the Central and North-West Coast. Consequences of wildfire depend on how much interface exposure there is – for instance the fire risk for Sea to Sky country may be moderate but given the high value of interface communities like Squamish and Whistler, the consequence of a wildfire on these communities would be high.
Performance Objectives	• Ensure that ROWs and facilities are maintained such that fuel debris levels are kept at or below what is permitted under the *Wildfire Act* and *Regulation*. • Have procedures in place across the company to ensure that wildfire risk is considered and documented in tailboards or in a risk evaluation form prior to undertaking maintenance activities that could be potentially rated as a high risk during the fire season period. Mitigation steps should be documented or the work deferred until the risk of ignition of a wildfire from the maintenance activity falls to an acceptable level. • Minimize the risk of wildfire ignition from trees growing into or falling into energized power lines or equipment. • Have a Fire Services Agreement in place with the Provincial Government to have a proactive plan in place to address the risk of wildfires impacting on critical infrastructure.
KPIs	• Fire probability/consequence models are prepared for all transmission corridors and electrical and communications facilities • Mitigation strategies are developed and in place for all critical infrastructure. • Number of fire incidents from contact with or ignition by energized electrical equipment: 0 • Number of fire incidents from personnel performing maintenance activities: 0

Asset Risks

Corporate Risk Scores:

- Severity S5 / Likelihood: L6 = 11 Environment
- Severity S3 / Likelihood: L7 = 10 Reliability

Wildfire is an annual danger to our power system each year –particularly during the active fire season, which typically runs from 1 March to 1 November. The severity of a fire season varies considerably from year to year. We had a particularly bad fire season in the summer of 2003, which damaged a lot of transmission and distribution infrastructure north of Kamloops to Clearwater. Both 2017 and 2018 were the worst two fire seasons on record that impacted various locations in the Interior – notably from Ashcroft north to Quesnel, Burns Lake and Telegraph Creek, and several scattered sites in the Kootenays. Although the 2017-18 fires were record breaking with over a million ha burnedboth years, they still had less impact on our transmission and distribution systems than expected – by chance, most fires burned in areas away from the power lines. The Wildfire Branch also put considerable effort into protecting critical substations and transmission assets. The greatest risk of wildfire impacts to the system are both environmental and reliability. Safety, financial, and reputational risks are also present but are more moderate in expected impact (levels 8-9).

Risks can occur to any part of the power system but transmission and distribution lines are the most vulnerable and have experienced damage in the past with burned woodpole structures and crossarms. Substations and generation sites are also vulnerable where situated in more remote areas outside a municipal fire zone, but as critical assets they are high priorities to protect in case of wildfires in the area. Both BC Hydro and the Wildfire Branch put considerable efforts into creating fire breaks or establishing sprinkler lines to protect critical infrastructure that is potentially threatened.

Asset Count, Condition, and Performance

2015-2017 Statistics:

- 13,460 km of Transmission corridor covering 76,760 ha
- 48,600 km of Distribution corridor, mostly along road allowance
- 294 substations, 33 generation sites, 18 Non-Integrated Area sites, 50 microwave and 29 passive reflector communications sites, and 79 woodpole and storage yards, many of which are in rural areas outside a community fire management zone
- 161 fires started along powerlines as identified by Wildfire Branch – 28 on transmission lines, 133 on distribution lines of which 25 are on lines managed by other utilities (i.e. FortisBC, oil/gas lines, IPPs, etc.). There are more fires on the Distribution system than Transmission likely because of relative length of exposure to various risk factors.

Number of Wildfires Involving Transmission or Distribution Assets 2015-2017

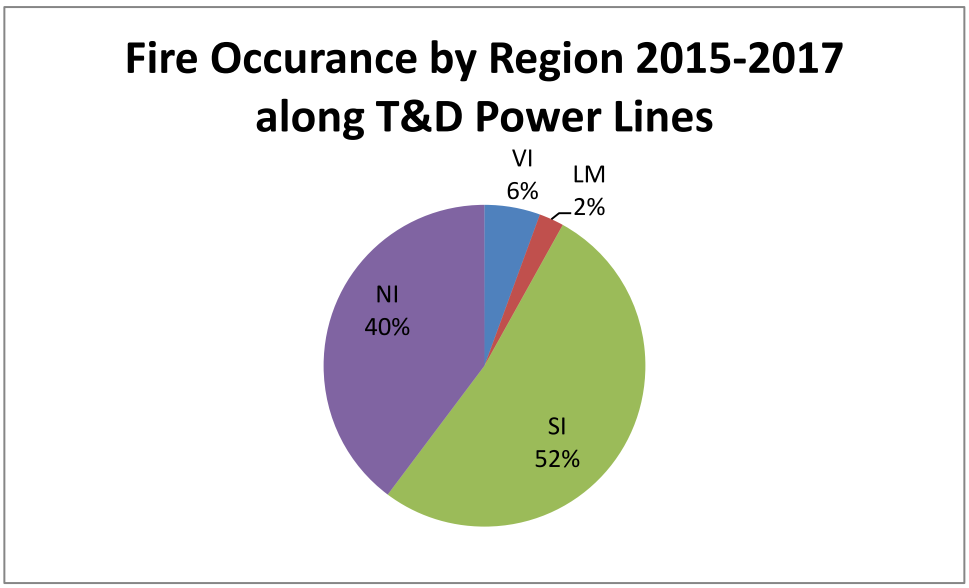
	2015		2016		2017		
Cause	**T**	**D**	**T**	**D**	**T**	**D**	**Total**
Trees	0	29	0	35	2	27	93
Landslide	1	0	0	0	0	0	1
Wires Down	0	1	1	1	4	4	11
Other Utility	6	7	2	2	4	9	30
No Cause Found	2	7	1	4	2	2	18
Line taken OOS to fight wildfire	1	0	2	0	1	1	5
Wind	0	1	0	0	0	0	1
Animal	0	1	0	0	0	0	1
MVA	0	0	0	0	0	1	1
Total	10	46	6	42	13	44	161

Most fires ignited along the transmission and distribution systems are small but on occasion such as in 2017, one or two fires can be large as they burned out of control for some time until contained. This was due to local conditions at the time and also availability of fire crews to address the fire.

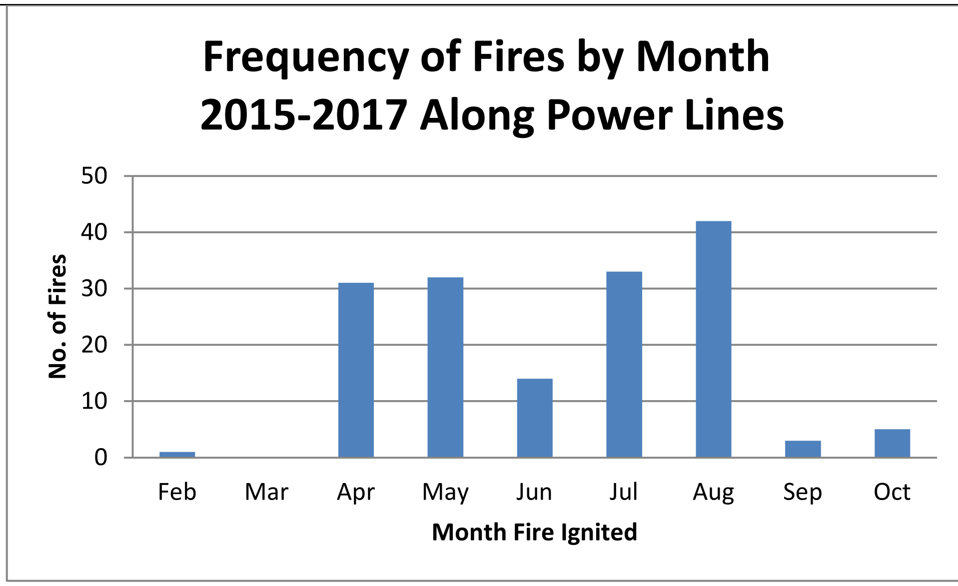
Area (in ha) affected by Wildfires and Power Lines 2015-2017

	2015		2016		2017		
Cause	**T**	**D**	**T**	**D**	**T**	**D**	**Total**
Trees	0	12.6	0	153.3	1035.2	576.3	1777.4
Landslide	0.1	0	0	0	0	0	0.1
Wires Down	0	0.3	2.6	0.4	1.1	0.8	5.2
Other Utility	348.7	44.9	7.0	0.01	8.8	2.4	411.8
No Cause Found	3.7	6.5	0.4	0.3	0.5	0.5	11.9
Line taken OOS to fight wildfire	0.7	0	12.0	0	0.1	2.0	14.8
Wind	0	0.8	0	0	0	0	0.8
Animal	0	0	0	0	0	0	0
MVA	0	0	0	0	0	0	0
Total	353.2	65.1	22.0	154.0	1045.7	582.0	2222.0

Most fires occur in the Southern and Northern Interior of the province.



Most fires also occur in the April to August time period with a few outlier fires in the shoulder months.



Asset Plan/Strategy

10 year plan:

- Fire Smart principles incorporated into facility site management plans.
- Maintain fuel debris levels on transmission and distribution lines to an acceptable level and create fuel breaks where feasible to reduce spread of wildlife along or off-ROW; reduce ladder fuels along a corridor edge.
- Training of staff – e.g. Safety courses in place (list).
- Risk assessment and mitigation documented in project development and work tailboards.
- Use of fire retardant gels or intumescent paints to protect wood structures; brushing around poles, and guys to reduce fuels in fire prone areas.

Acquire: BC Hydro has probability/consequence data concerning wildfire risks for most of the transmission system that is stored and viewable in PowerGrid. This data should be reviewed and updated to include new transmission corridors that have been added in recent years. BC Hydro has had various forms of fire protection agreements with the Province dating back to the late 1970's. The agreement has evolved over the years to address changing regulations and is currently managed with the Wildfire Branch by Asset Sustainment. It ensures we have provincial firefighting support to protect critical infrastructure.

Operate: In the event of wildfires impacting or threatening the power system, BC Hydro has the ability to activate corporate and regional emergency operations centres that can communicate with the Provincial Emergency Program, various provincial agencies including the regional Fire Centres, and within BC Hydro including Real Time Operations (RTO). RTO has the ability to put in place no reclose restrictions on lines that are at risk to reduce the potential for igniting wildfires from downed power lines until they are assessed. The emergency operations centres can coordinate activities to address specific threats to BC Hydro infrastructure to avoid or minimize damage and to effectively coordinate repairs.

Maintain: BC Hydro has active maintenance plans for all of its lines and facilities to minimize the potential for wildfire ignition. The vegetation programs are particularly important in ensuring that wildfire do not rapidly spread on or along our corridors and key sites have fire breaks incorporated to protect assets. Regular inspections to prevent vegetation encroachments are important and fuel debris mitigation during brushing operations help reduce these risks. Line maintenance is also important to ensure that power lines are in good operating condition. Incorporating a number of strategies noted above in a 10-year plan will help deal with emerging

	risks associated with increased potential for wildfire activity associated with climate change.
Prioritization for Replacement	Not applicable
Spares Strategy	Not applicable
Implementation Risks	See *Asset Risks* above.
Non-Implement-ation Risks	Failure to have effective wildfire mitigation strategies in place could place critical infrastructure at an unacceptable risk and lead to major power disruptions in the affected area.
Business / Financial Implications	Loss of critical assets could lead to timely and costly delays in replacing damaged equipment (e.g., transformers or other key assets in a substation, communications equipment, wood poles, or structures on rights of way). Failure to effectively avoid ignition of wildfires started by contact with energized electrical equipment could result in investigations by the Wildfire Branch and lead to legal proceedings against BC Hydro. This risk is particularly high if BC Hydro does not maintain a Wildfire Services Agreement in place with the Province, or if we are not seen to adhere to good utility maintenance practices. Wildfire risks pose safety, environment, financial, and reputational risks to BC Hydro if not effectively addressed.
Time Frame	Ongoing. Risk evaluation is updated annually and prevention and risk mitigation strategies are revised as necessary. Current Fire Services Agreements with the Province have been on a 3-year renewable timeframe and the current agreement expires in March 2019.
Linkages	Maintenance Programs for: • Transmission and Distribution Lines • Transmission and Distribution Vegetation • Substations Maintenance • Communications System Maintenance (i.e., microwave system) • Generation Facilities
IT Systems	BC Hydro Corporate Geographic Information System, PowerGrid interface
References	• *Wildfire Act* and Regulation • *Forest Act* • Fire Services Agreement between Province of BC, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Wildfire Branch and BC Hydro, 2016-2019 • Corporate Safety Training Modules • Access Wildfire Area Checklist • Wildfire Management Daily Work Plan (WMDWP) • Vegetation Standards: • Vegetation Maintenance Standards • CR-3660-1 FP Innovations study on temperature profiles above debris burn piles • Line Maintenance Standards:
Consultation	Corporate Safety, Fire Marshall

	Senior Treasury Portfolio Manager, Risk & Insurance, Treasury		
Responsibility/ Program Engineer	Tom Wells	Date: Oct 2018	Version 2

COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 4

Wildfire Response Procedure

Wildfire Response Procedures

The following procedure describes how BC Hydro responds to impacts from wildfires.

Rescue / Remove

Rescue or remove any persons from the immediate scene, if it is safe to be done for all involved.

Extinguish / Evacuate

If you have necessary training, and are able, and have appropriate tools, extinguish the fire, or evacuate the area.

Report

Ensure all fires have been reported to the province wildfire, and as per the following protocols.

Coordinate

Follow protocols to ensure authorization has been provided to operate in an area impacted by a wildfire

Contents

Revision History

No.	Date	Revised By	Description
0	May 2015	Greg Ryley	Initial issue
1	March 2017	Greg Ryley	General revision
2	July 2018	Greg Ryley	Mike Guite provide majority of edits: Format and reference to Transmission planning
3	May 2019	Greg Ryley	Added danger tree re-assessment as per corrective action #9 from Wildfire 2018 season
4	April 2020	Greg Ryley	Simplified and aligned with emergency event safety protocols

Framework

Fire Incident Management Teams from Ministry of Forestry, Lands and Natural Resource Operations (FLNRO) BC Wildfire Services (BCWS) will be the lead agency to manage wildfire response.

BC Hydro will coordinate its response on affected areas with BCWS, external agencies and key stakeholders (first nations, customer relations, etc.) under the Province's emergency response framework (BCEMS).

On recommendations from BCWS, local authorities (Regional Districts, First Nations, and Military) will issue for areas under threat of fire within their jurisdictions evacuation alerts, orders and rescinds.

Depending on job function, BC Hydro staff may have additional duties for protection and restoration of BC Hydro facilities.

Wildfire Management Planning

Refer to separate **Wildfire Management Planning - Transmission** document for asset planning instructions. Instructions are role-specific, and may include activities to be undertaken prior to fire season, daily activities during fire season, and the specific procedures for wildfires impacting BC Hydro assets.

Wildfire Response – Procedures

1. **Ensure notification**

If there is risk to BC Hydro people or infrastructure notify the following:

- BC Wildfire services*** 1-800-663-5555 or *5555 from cell
- A senior manager
- Fraser Valley Operations (FVO) 1-604-455-1730
- Hydro Restoration Centre (HRC) 1-877-854-8777
- Duty Coordinator (ask for Duty Coordinator) 1-877-311-8611

***If you or your staff causes a wildfire, it is required to contact BC Wildfire Services, regardless if the fire is extinguished.

BC Hydro Restoration Centre is the single point of contact for BC Wildfire Services to notify BC Hydro. See **Appendix 1** on how this information is received and distributed.

2. **Familiarize yourself with the wildfire**:

Use Emergency Operations Dashboard web based mapping application to identify the fire location, BC Hydro assets and evacuation notices. Your computer must be on corporate network to access the application.

3. **Coordinating response to impacts to BC Hydro infrastructure**

BC Hydro will either activate an Emergency Centre to support response, or coordinate locally if the event is of a smaller scale. The decision to activate an Emergency Centre is typically with a Senior Manager. Key response activities include:

a) Coordinate with BC Wildfire Services and other agencies as required consider:
   - Community Relations staff support in external Emergency Operation Centres.

b) Coordinating appropriate resources to plan for and address all hazards. Consider:
   - OSH Specialists
   - Aircraft operations
   - Vegetation management

c) Follow Safety Protocols for Emergency Events

d) Develop a damage assessment plan

e) Ensure appropriate level of reporting to senior management or emergency centre

f) Obtain financial support for response

Appendix 1 Notification Process

- The Hydro Restoration Centre (HRC) will take calls and emails from local authorities who are providing direction related to escalate and de-escalate Evacuation Alerts or Orders.

- On a new Alert **between 7:00am – 10:00pm**, the HRC will call the managers/standby managers with details of area affected and supply contact names and numbers for the originating jurisdiction.
- On a new Alert **between the hours of 10:00pm – 7:00am**, the HRC will email the managers/standby managers with details of area affected and supply contact names and numbers for the originating jurisdiction.
- The managers/standby managers will provide the details of the Alert to their staff/crews and orient them with operational requirements in an area under Evacuation Alert, including the requirement to check in and out with HRC on 1-877-854-8777.
- On a change from an Alert to an Order, HRC will call the managers/standby managers by phone and email. HRC will call all crews who have reported that they are working in the area and notify them to cease work as safely and quickly as possible and leave the area based on the direction provided in the Order.
- When an Evacuation Alert or Order has been lifted or removed, HRC will call the in charge managers / standby managers by phone and email so that crews can move back into areas to work in a timely fashion.
- On a new Evacuation Order the HRC dispatcher will call the managers/standby managers with details of area affected and work with the managers/standby managers to identify any crews/staff in the area and notify them of the immediate requirement to leave the area and provide any details on the Order.
- Upon notification by the HRC on Alerts and Orders, managers/standby managers will contact and inform assigned Properties Managers of the information.

BC Hydro
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COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 5

Corridor Integrated Vegetation Management Program

Integrated Vegetation Management Plan

For BC Hydro Transmission and Distribution Power Line Corridors

Confirmation Number: 105-0982-16/21



BC Hydro
Power smart

May, 2016

BC Hydro
Transmission, Distribution and Customer Services
Asset Sustainment, Vegetation Strategy and Standards Department
6911 Southpoint Drive (B03)
Burnaby BC V3N 4X8

First published July 2005 (Transmission) and June 2011 (Distribution)
Revised and republished April 2008 and July 2010 (Transmission) and December 2010 (Distribution)
Current plan draft: May 2016.

Acknowledgements / Signing Authority:

This document is the responsibility of BC Hydro's Transmission and Distribution Vegetation program**:**

Primary Contact: Tom Wells, Telephone: 604-516-8943

(Technical writer: Joyce Arthur, Duncan Kent & Associates Ltd., Vancouver)

Notice: Both federal and provincial legislation contain information required and pertinent to this *Integrated Vegetation Management Plan for BC Hydro Transmission and Distribution Power Line Corridors*. As well, many other individuals, organizations, companies, and vegetation experts have cooperated in providing information and sources for this IVMP document.

This IVMP document is essentially a set of best practices and guidelines compiled from knowledgeable and experienced industry and government personnel. It is intended to provide the owner, operator, and contractors with advice regarding the specific topic. The recommendations set out in this IVMP are meant to allow flexibility and must be used in conjunction with competent IPM practices and judgment. It remains the responsibility of the user of the IVMP to judge its suitability for a particular application.

If there is any inconsistency or conflict between any of the recommended practices contained in the IVMP and the applicable legislation requirements, the legislative requirements shall prevail. Every effort has been made to ensure the accuracy and reliability of the data and recommendations contained in the IVMP.

Table of Contents

Chapter 1, Introduction

About BC Hydro

BC Hydro is a British Columbia provincial Crown corporation, and one of the largest electric utilities in Canada. The company's mandate is to generate, purchase, transmit, distribute, and sell electricity.

BC Hydro distributes electricity produced by several hydroelectric, thermal, and other generation facilities to the majority of B.C.'s population. BC Hydro also purchases power from Independent Power Producers (IPPs) or from the open market.

Hydroelectric plants consist of a dam, a reservoir, a powerhouse, and a switchyard. At each hydroelectric plant, water from a reservoir flows into the powerhouse. The flowing water turns turbines (rotating blades), which in turn drive generators. Thermal plants operate similarly, except the energy used to turn the turbines is produced by natural gas, diesel, or biofuels. Generators convert the turbine's mechanical energy into electrical energy. Transformers located within switching stations convert the generators' low-voltage electricity to a higher voltage, between 60,000–500,000 volts, to move power over long distances via transmission lines to substations.

BC Hydro has over 18,390 km of transmission lines within power line corridors that cover approximately 77,015 ha of land. In substations, the voltage is reduced for delivery to customers over distribution lines that operate at voltages below 35,000 volts. BC Hydro has over 48,500 km of overhead primary distribution lines located primarily along road allowances.

About this Plan

This document is an Integrated Vegetation Management Plan (IVMP) for the maintenance of vegetation on transmission and distribution power line corridors operated by British Columbia Hydro and Power Authority (BCH). It has been prepared in accordance with Section 58 of the Ministry of Environment’s *Integrated Pest Management Regulation,* or IPMR (note subsection references in major headings) and is based on **Integrated Pest Management (IPM)** principles.

It confirms BC Hydro’s strategy to employ herbicides under the *Integrated Pest Management Act* (IPMA) and the Integrated Pest Management Regulation (IPMR). This plan is intended to cover a five year period from 2016-2021 pending confirmation by the Ministry of Environment.

In compliance with Pest Management Plan requirements outlined by the BC Ministry of Environment, this IVMP includes the following information:

- The program for controlling vegetation along power line corridors, using the principles of integrated vegetation/pest management

- The process for planning, selecting, using, and evaluating control methods within that program
- The methods for handling, preparing, mixing, applying, and otherwise using herbicides within that program

This IVMP is intended to be used by BC Hydro, its agents, and contractors to carry out vegetation management work on all power line corridors.

This plan does **not** cover vegetation control or herbicide use at other BC Hydro facilities such as electrical substations, generation switchyards, generating sites (hydroelectric dams or thermal plants), communications sites, storage sites, administrative buildings, or land owned or leased for future facilities. Vegetation management at these facilities is covered by a separate IVMP. It also does not cover the use of wood preservatives in the wood pole test and treat program which also has its own separate pest management plan.

Aerial applications of herbicides are not permitted under this plan

Integrated pest management (IPM) as defined by the *Integrated Pest Management Act* is a process for managing **pest** populations that includes the following elements:

- Planning and managing ecosystems to prevent organisms from becoming pests;
- Identifying pest problems and potential pest problems;
- Monitoring populations of pests and beneficial organisms, damage caused by pests and environmental conditions;
- Using injury thresholds in making treatment decisions;
- Supressing pest populations to acceptable levels using strategies based on considerations of:
  - Biological, physical, cultural, mechanical, behavioural and chemical controls in appropriate combinations, and
  - Environmental and health protection; and
- Evaluating the effectiveness of pest management treatments.

Integrated vegetation management (IVM) is a system of managing plant communities in which compatible and incompatible vegetation is identified, action thresholds are considered, control methods are evaluated, and selected control(s) are implemented to achieve specific objectives. Choice of control methods is based on effectiveness, environmental impact, site characteristics, safety, security, and economics. IVM is considered a **best management practice** in utility vegetation management as the most effective, safe, economical, and environmentally sound procedure(s) for maintaining electric rights-of-way. (From ANSI Standard A300, part 7.)

Pest: an organism that is damaging, noxious, or a nuisance. For the purposes of this plan the focus is on vegetation that can interfere with the safe and reliable operation of the power system or damage equipment or facilities.

Best Management Practices are the best available and industry-recognized courses of action based on scientific research and current knowledge of a given discipline, considering the benefits and limitations of existing options.

Person Responsible, Section 58(1)(b)(c)

58 (1) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following identifying information;

(b) the person responsible for managing pests in relation to the land described in paragraph

(c) the name and phone number of an individual who is the principal contact for information relating to the pest management plan.

The person listed below is responsible for administering the IVMP provincially and is the principal contact for information relating to the plan:

Tom Wells, Vegetation Program Manager, Asset Sustainment, *Transmission, Distribution and Customer Services* 604-516-8943

Geographic Boundaries, Section 58(1)(a)

58 (1) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following identifying information;

(a) a description of the geographic boundaries of the area to which the plan applies and maps or diagrams showing the proposed treatment areas within that area;

This IVMP includes all BC Hydro-managed transmission and distribution lines in British Columbia. For operational purposes, BC Hydro divides the province into four regions: Vancouver Island, Lower Mainland, Southern Interior, and Northern Interior. Each of these regions has differing characteristics and needs.

The IVMP covers all areas in the province wherever BC Hydro has transmission or distribution assets.

More specifically, the IVMP covers vegetation management, including the use of herbicides, within or adjacent to the boundaries of BC Hydro transmission or distribution power line corridors. It also covers Hydro facilities associated with these corridors, such as:

- Helicopter landing pads
- The base of towers and other electrical structures
- Lands occupied by equipment storage sheds
- Access roads and adjacent lands leading to the ROW or other facilities that BC Hydro manages
- Highway easements
- The base of wood pole structures

It also covers areas where:

- BC Hydro structures and equipment are located
- BC Hydro is authorized to manage as per Section 20 of the *BC Hydro & Power Authority Act*
- BC Hydro is authorized to manage as per its right-of-way agreements
- Areas adjacent to the ROW that are currently under active management

Finally, the IVMP allows the treatment of noxious weeds and invasive plants on all power line corridors and areas listed above.

Transmission Lines

BC Hydro maintains over 18, 390 km of transmission lines (60 kV to 500 kV) along 13, 275 km of corridor covering over 77,015 ha. We will be adding a further 365 km of transmission lines covering 1,895 ha of corridor over the five-year period covered by this plan to meet the growing needs for electric power in B.C. Most transmission corridors run cross-country in rural or undeveloped areas on statutory rights-of-way but many lower voltage 69 kV circuits are along road allowances. The legal widths of transmission rights-of-way vary from 10 metres to about 300 metres. Individual transmission lines vary in length from 1 to 500 kilometres.

Here is a link to a provincial map of the transmission system: https://www.bchydro.com/energy-in-bc/our_system/transmission/transmission-system/maps.html

Right-of-way (ROW): usually defined legally as the right to pass over or use land owned by another party for a specific purpose, e.g. to build, operate and maintain a power line, roadway or railway. Most transmission and some distribution lines owned and maintained by BC Hydro are situated on statutory rights of way that spell out the legal rights and obligations of both the utility and the landowner. ROWs may pass over Crown lands, First Nations treaty or reserve lands, or private property.

Distribution Lines

BC Hydro maintains approximately 48,500 km of overhead distribution lines (less than 35,000 volts) across B.C. Most distribution lines in B.C. are located on Ministry of Transportation rights of-way or municipal road allowances. A few distribution lines are located:

- Cross country in rural or undeveloped areas (i.e., areas where power lines pass through undeveloped land and are not accessible by road)
- On private land easements or Crown rights-of-way
- On a license of occupation

The corridor width is generally five to seven metres but may be much wider on cross-country sections.

Areas where BC Hydro does not carry out distribution operations include: the City of New Westminster, the City of Kelowna, areas of the Kootenay and Boundary Districts between Creston and Rock Creek, the Similkameen Valley, and the Okanagan Valley south of Summerland to the Canada/US Border.

Attached and marked as Schedule 1 is a map depicting the geographic boundaries of the BC Hydro distribution service area.

Why Control Vegetation?

BC Hydro must control vegetation under, above, and near its power lines in order to maintain the safe and reliable transmission and distribution of electricity to its customers.

BC has some of the tallest and fastest-growing trees in North America. Many can pose risks to the safe and reliable operation of the power system if they grow in close proximity or fall onto to energized equipment. This includes conifer species such as Douglas-fir, spruce, and pine; and deciduous species such as alder, birch, aspen/cottonwood (poplar species), and maple.

BC Hydro’s vegetation management program must:

- Minimize public and worker safety hazards
- Reduce the number of outages due to vegetation growing-into or falling-onto power lines
- Reduce the risk of fires caused by trees contacting the lines
- Allow access and lines of sight for maintenance and security

BC Hydro is mandated to manage its transmission and distribution power line corridors as per section 20 of the *BC Hydro Power and Authority Act*, and according to the terms of right-of-way agreements.

As a utility in North America and as directed by the British Columbia Utilities Commission (BCUC), BC Hydro is required to adhere to the North American Electric Reliability Corporation (NERC) standard FAC-003-3 or subsequent versions, *Transmission Vegetation Management*. This standard is designed to avoid wide-scale outages on the bulk electric transmission system by preventing trees from growing-into the power lines as well as minimize the risk of trees falling-into the power lines.

BC Hydro manages vegetation on its power lines on a cyclical basis using a variety of manual, mechanical, cultural, biological, and chemical **control methods**. This includes pruning, hazard tree removal, mowing, brushing, grubbing, girdling, and herbicide application as well as encouraging compatible use of the land. The method or combination of methods chosen to control vegetation on a particular site is based on the IVM decision-making process outlined in this document.

Control methods:

- *Manual and Mechanical control* are physical controls of vegetation that include activities such as pruning, hazard tree removal, mowing, brushing, grubbing, and girdling.
- *Cultural control* is management of vegetation in a way that suppresses the growth of incompatible target species through the use of crops, pastures, parks or other managed landscapes, e.g. compatible use.
- *Biological control* methods involve the reduction or suppression of unwanted organisms by introducing or enhancing the presence of natural enemies, such as insects, fungi, or compatible competitive plants. It is often used in noxious weed/invasive species control.
- *Chemical control* is management of incompatible vegetation through the use of herbicides.

Objectives of the Vegetation Management Program

The purpose of vegetation management is to implement cost-effective programs that will maximize public and worker safety and service reliability.

BC Hydro will utilize the principles of Integrated Vegetation Management to control **target vegetation**. Regular inspections of the transmission and distribution system are conducted to determine when vegetation needs to be managed based on electrical clearance requirements and also to determine the location of **hazard trees**. Where possible, vegetation that could grow-into or is expected to fall onto transmission or distribution lines is removed. If removal is not possible, pruning of trees using proper arboricultural practice is completed to achieve the required safe clearances as described in this IVMP.

Target Vegetation: for power line corridors, any plant species capable of contacting or growing within the limits of approach of power lines must be managed to ensure the safe and reliable operation of the power system.

Hazard tree: a tree that has a defect or adverse environmental condition that predisposes it to failure and which has a target that can be damaged if it falls (e.g. a power line, electrical equipment, buildings, people, etc.). Tree risk assessments are used to identify hazard trees and those with significant risk indicators are then prioritized for removal to protect public and worker safety, property and power system assets.

The long-term objective, where possible, is the conversion of the power line corridors from dense stands of tall-growing species that are created by continuous mowing and brushing into low-growing stable plant communities of more desirable plants, such as compatible berry bushes, low-growing shrubs, and wildflowers.

There are four main ways of managing the utility corridors to achieve the goal of a stable low-growing plant community:

Selective control — Control methods are targeted at specific vegetation, based primarily on height and species, so that low-growing species are left intact and encouraged. Shrubs and indigenous plants that are naturally present on the site will help to suppress tall-growing species.

Compatible use — BC Hydro encourages the use of power line corridors for activities that will not conflict with safe and reliable operation of transmission or distribution lines, such as recreational or agricultural uses.

No clearing required (NCR) — Areas do not need to be cleared where trees at their mature height will never come within the "limits of approach" (minimum allowable distance between vegetation and the conductor) at the maximum "conductor sag" (degree to which the line could sag towards the ground). NCR sites are those that will never require vegetation maintenance because they pose no threat. This scenario is most applicable to transmission lines.

Altering existing vegetation — In cases where it is impractical to remove undesirable species from along the edges of the corridor, existing vegetation can be modified by pruning to maintain clearances from conductors, thus protecting the power lines.

The vegetation management program objectives are to:

- Comply with the provisions of the IPMA and all applicable government laws or regulations and BC Hydro corporate policies.
- Ensure vegetation management practices and procedures (including herbicide use) are safe; environmentally sound, practical, effective, socially responsible, and cost efficient.
- Respect agreements with the public, landowners, and other stakeholders.
- Respect First Nations' aboriginal and treaty rights.
- Communicate our vegetation management activities with clarity to the public.
- Employ innovative practices.
- Integrate vegetation management information with a geographical information system (GIS) to better plan and track work history and identify key features on the utility corridor.
- Utilize a hazard tree rating and removal system.

Benefits of a Low-growing Plant Community

In combination with other control methods, herbicides can assist BC Hydro by restricting the growth of tall-growing vegetation while promoting growth of favorable, low-growing species. Once this site conversion is complete, it requires less intensive maintenance, which reduces disruption to the natural environment over the long term, and helps reduce herbicide use. Over time, this can reduce impacts on fish, wildlife, water bodies, and the general public.

Successfully establishing a low-growing stable plant community has many advantages. It:

- Increases public safety and system reliability by reducing the risk of tree contact with power lines
- Enhances biodiversity by increasing the number of low-growing forage species and improving wildlife habitat on utility corridors
- Improves the recreational opportunities on utility corridors by eliminating dense thickets and slash
- Improves aesthetics as utility corridors are becoming important green spaces
- Allows people and communities to use utility corridors more effectively for hiking, biking, berry-picking, or other compatible uses
- Permits access and maintains lines of sight for maintenance
- Reduces the total area requiring future routine vegetation control
- Results in sustainable long-term vegetation maintenance costs

Reasons for Herbicide Use

The careful, limited use of herbicides is an essential part of IVM on BC Hydro power line corridors, as they provide effective vegetation control especially when used in combination with other physical, cultural, and biological control methods. On an annual basis, herbicide use accounts for approximately 20% of BC Hydro's vegetation management work on transmission and 5% on distribution. They are used only in specific circumstances in carefully selected areas.

Selective Use of Herbicides

Using IVM, BC Hydro applies low amounts of herbicides to selectively control undesirable vegetation (mostly tall-growing trees and noxious weeds). Selective use of herbicides allows desirable low-growing vegetation to flourish, such as grasses, wildflowers, ferns, and low-growing native shrubs.

Most targeted applications on power line corridors are completed with hand-held sprayers. Herbicides may also be injected into tree stems or brushed onto the cut surfaces of stumps to prevent regrowth. BC Hydro does not utilize aerial (helicopter or airplane) spraying of herbicides on its power line corridors.

Compared to previous decades, today's herbicide applications are more selective than ever before, and BC Hydro is continually reviewing new technologies and alternatives.

Herbicide: a pesticide used to control or manage plants. Pesticides are a chemical substance or mixture of substances intended for killing, controlling, or managing organisms considered to be pests.

Deciduous Tree Control

Herbicides are used primarily on tall-growing deciduous trees because they are fast-growing and quick to re-sprout, compared to conifers. When conifers are cut below the lowest branch, they will not regrow. The quick re-sprouting of deciduous species creates more biomass and more debris for the next cycle. As stem densities increase, the ability of wildlife and people to access and use the right-of-way diminishes and the slash buildup can pose risks in the spread of wildfire. Use of herbicides will prevent this re-sprouting and reduce those risks.

Environmental Benefits

The *Migratory Bird Convention Act* prohibits the disturbance or destruction of birds' nests. BC Hydro cannot feasibly conduct all vegetation management outside of the bird nesting season, but some selective herbicide application methods can allow effective control of vegetation without damaging nests.

Studies indicate that herbicide-managed sites can have a greater volume of wildlife forage compared to mowed sites. This is because the site objective of a low-growing stable plant community favours vegetation species used by browsing wildlife.

Some vegetative species at risk can be protected by using a stem-applied treatment to control competing target species. Instead of sites being taken over by rapid, high-density regrowth from physically cut deciduous species, treated stems die slowly, allowing sensitive plant species more time to grow and thrive.

Limitations of Physical Methods

The use of non-chemical control methods alone has proven to be ineffective for the long-term management of undesirable vegetation on power line corridors. This is especially true in B.C., where transmission and distribution lines often run through remote geographic areas.

Fire Risk

Tree cutting or brushing operations using chainsaws may build up vegetative debris on rights-of-way over time, which increases the "fuel load," or risk of fire.

BC Hydro is subject to the *Wildfire Act* and *Regulation*, which requires us to maintain power line corridors in a condition that would not start or cause a fire to spread. Therefore, we must implement programs to reduce the fuel load created from vegetation management activities.

Frequent Disturbances

Reliance on physical control methods requires more frequent intrusions onto a site as deciduous targets with well-established root systems grow rapidly and form dense thickets with repeated cutting. In turn, this increases the disturbance to wildlife and the environment.

In contrast, herbicides provide more selective long-term control, reducing the need for frequent manual or mechanical treatments. A 2005 BC Hydro study showed that over a 10-year period, using only brushing to control vegetation would cost almost twice as much as combining brushing with herbicides. Selective herbicide use reduced the target densities requiring control in the subsequent maintenance cycles and also reduced slash debris which needed to be managed.

Increased Regrowth and Density

Without the complementary use of herbicides, continuous physical cutting of target vegetation on some sites results in decreased vegetation control effectiveness over time. Trees such as alder, birch, aspen/poplar, and maple re-sprout quickly from cut stumps and established roots often forming multi-stemmed thickets resulting in high densities of tall-growing trees after repeated mowing or brushing. Follow-up use of herbicides prevents this regrowth and reduces target densities to manageable levels.

Environmental Harms

Some physical techniques such as mowing may facilitate soil erosion in some areas, which can negatively impact fish-bearing water bodies.

There is more potential for mowing or brushing to destroy bird nests and habitat for burrowing animals, compared to herbicide applications.

Physical techniques often use heavy machinery that is more likely to damage non-target vegetation and the natural environment.

Mechanized equipment can cause rutting, track marks, or degradation of the ground surface. For this reason, mechanical methods often cannot be used in areas with archeological features that could be disturbed.

Mechanical equipment has a higher inherent carbon footprint from fuel consumption and emissions.

Safety Hazards

The use of hand tools and mechanized equipment can be hazardous. The risk of accident and injury among workers is far greater when using mechanical means of controlling vegetation than when selectively applying herbicides.

Some equipment may be impractical to use in remote or inaccessible areas, as well as dangerous in some terrain, such as on land with steep slopes or large rocks. In these areas, brushing or selective herbicide applications are the only feasible techniques to control vegetation.

Increased slash and root mass from the sole use of mechanical methods creates physical hazards for wildlife, people, and equipment, and impedes service vehicle access.

Control of Invasive Plants and Noxious Weeds

Control of noxious weeds and their seeds is regulated by the *Weed Control Act* of British Columbia. Noxious weeds are invasive plants that can displace native vegetation and reduce wildlife habitat and forage.

> **Noxious weeds** are plants that are injurious to public, health, crops, livestock, land, or other property and which must be controlled under the *BC Weed Control Act*. For the purposes of the IPMR, a weed or invasive plant is defined to include the entire plant in all its growth stages, including roots, seeds, rhizomes, runners, suckers, shoots, seedlings and mature plants.
>
> An **invasive plant** is an alien plant species that has the potential to rapidly spread and pose undesirable or detrimental impacts on humans, animals, or ecosystems.

Herbicides are an important method used to control invasive plants and prevent their spread and are often the most economic and environmentally sound solution. Physical methods alone often cannot control invasive plants, especially when they become established. For example, mowing stimulates the production of species such as orange hawkweed, thereby increasing the weed population. Also, mechanical techniques can spread noxious weed seeds to other locations.

BC Hydro is not subject to the *Weed Control Act* on land that it does not own. However, BC Hydro recognizes the environmental damage caused by noxious weeds and has implemented programs to control invasive species where practicable along power line corridors. Vegetation management personnel and contractors are trained to identify the species of noxious weeds on the Provincial list through education programs. Workers are also familiar with ways to reduce the spread of noxious weeds, such as inspecting vehicles. Finally, BC Hydro supports research into new control methods, such as the use of insects for biological control.

Regulation and Safety of Herbicides

The safety of the public, BC Hydro staff, and its contractors is paramount. The herbicides used by BC Hydro are approved by Health Canada's Pest Management Regulatory Agency (PMRA). All registered herbicides have undergone stringent evaluation and testing by the PMRA to ensure they pose no unacceptable risks to people and the environment when used according to the label.

BC Hydro does not use herbicides that are "known, or reasonably anticipated to be carcinogenic" as determined by the International Agency for Research on Cancer (IARC) or the US National Toxicology Program. Reputable scientific studies have shown that the active ingredients of the most common herbicides used by BC Hydro are of low or extremely low toxicity to people, fish, and wildlife (mammals). For example, two of the most commonly used herbicides – triclopyr and glyphosate – break down quickly in the soil.

Extra caution is exercised when herbicides are applied around environmentally sensitive areas and areas where food for human or livestock consumption is grown or located.

All herbicide use must abide by applicable federal and provincial legislation and their regulations, including BC's IPMA and IPMR, and the federal *Pest Control Products Act*. It is illegal to treat pests with products not governed by this legislation or to use a herbicide in a manner inconsistent with its product label. Applications are planned carefully, using registered herbicides formulated for specific application methods.

BC Hydro recognizes the importance of protecting aquatic, marine, and riparian ecosystems to ensure their long-term sustainability. Pesticide-free Zones (PFZ) protect environmentally-sensitive areas, such as bodies of water, watersheds, wells (domestic and agricultural), and water intakes. A PFZ is a zone (usually 10m) around an area of land that must not be treated with pesticides, and must be protected from pesticides moving onto it. Herbicide applicators do not apply herbicides within PFZs.

Herbicides are applied by Certified Pesticide Applicators, who are licensed by the Province after writing a provincial exam. They are specially trained and qualified to apply herbicides safely, following stringent legislative requirements.

BC Hydro's Work Planning Process

BC Hydro operates under a long-term strategic vegetation maintenance plan as well as annual operational plans. Planned activities are based on the growth rates of target vegetation and proximity to the power lines as determined by inspection. This information is used to optimize the length of the maintenance cycle for a given vegetation management area, as well as to estimate future work and budget requirements.

This province-wide IVMP provides general guidance for the use of herbicides within an integrated vegetation management decision-making process. Before herbicides are applied at a specific location, a detailed site prescription is prepared for the site, including maps that identify all bodies of water and other environmental issues. BC Hydro's standard operating procedures are provided to contractors before work begins. Layout crews flag the work areas in the field to ensure that all PFZs have been properly identified and marked before any herbicide applications begin. Where appropriate, individuals are notified before work begins and signs are posted at all treatment sites.

Chapter 2, Elements of Integrated Vegetation Management

This chapter describes BC Hydro's Integrated Vegetation Management Program, as per Section 58 of the provincial IPMA (information required for Pest Management Plans). It covers:

- Prevention program – Section 58(2)(a)
- Identification of species – Section 58(2)(b)(ii)
- Monitoring program – Section 58(2)(c)(i)(ii)(iii)
- Action (injury) thresholds – Section 58(2)(d)(i)(ii)
- Treatment methods – Section 58(2)(e)(i)(ii)(iii)(iv)
- Evaluation program – Section 58(2)(f)

Prevention, Section 58(2)(a)

58 (2) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements;

(a) a description of the program that will be employed to prevent organisms from becoming pests;

Prevention means stopping target vegetation from becoming established, as opposed to treating existing target vegetation. BC Hydro's vegetation management program is preventive in nature when stable, low-growing plant communities are established along power line corridors.

Examples of preventive measures that BC Hydro uses on utility corridors include:

- **Natural controls**, primarily the establishment of stable, low-growing plant communities that out-compete taller growing species
- **Site preparation**, such as seeding programs to reduce establishment of target vegetation in disturbed areas with exposed soils or removal of stumps and roots
- **Compatible use**, such as agricultural crops, golf courses, or parking lots
- **Non-vegetation techniques** to provide more clearance, such as physical re-contouring of the land, and raising conductor heights to avoid contact with vegetation

Planting the Right Tree in the Right Place

Trees along road allowances and boulevards often exceed 6 metres in height at maturity and may pose safety and reliability risks depending on their location relative to the power lines. BC Hydro works with local governments and landowners to replace incompatible trees that must be removed, with more suitable species that require much less maintenance.

A list of ornamental trees and shrubs that are compatible with transmission and distribution lines can be found in the BC Hydro publication entitled *Planting Near Power Lines – A Guide to Vegetation Recommended for Planting and Growing Near Power Lines.* It is available at this link: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/safety/planting-near-power lines.pdf

Clearing for New Line Construction

Initial clearing of vegetation for power lines establishes future vegetation management activities and associated long-term costs. When a new power line corridor is constructed, all tall-growing target tree species or other incompatible vegetation are removed within the right-of-way, as well as any hazard or non-windfirm trees outside the corridor that can fall into the power lines.

Whenever possible, tall-growing species are selectively removed, leaving low-growing species intact and undisturbed. Deciduous species can aggressively re-sprout from the stump or roots after being cut, forming dense thickets. They may be selectively treated with herbicide to avoid this.

Identification of Species,
Section 58(2)(b)(ii)

58 (2) (b) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements – either:

(i) a description of the program that will be employed to identify pests targeted by the plan, or
(ii) identification of the pests targeted by the plan;

Vegetation to be controlled on transmission and distribution corridors includes trees or in some instances tall-growing shrubs that have the potential to reach or exceed the limits of approach to the line (see page 20, *Action Thresholds*, for information on limits of approach). Most other vegetation along power line corridors can remain to improve biodiversity and to act as competitive cover to reduce the regrowth of target vegetation.

The accurate identification of target vegetation, on or adjacent to BC Hydro power line corridors, is important for these reasons:

- Control may or may not be required, depending on vegetation growth rates, height at maturity, characteristics such as susceptibility to rot, windthrow, or branch-breakage, and physical location.
- Control methods may differ depending on the plant species. Some may be easily controlled by non-chemical methods, while others may only be

effectively managed through a combination of physical, cultural and chemical methods.

Vegetation Categories

Categories of vegetation encountered along and adjacent to BC Hydro power line corridors include:

- **Desirable vegetation** comprises species that when mature will not interfere with the power system or the overhead conductors, either due to their maximum growth height, proximity to the lines, or a combination of both. This includes ferns, grasses, sedges, wildflowers, and low-growing shrubs and trees. The vegetation management approach to all desirable vegetation is to encourage its retention and propagation. The presence of appropriate low-growing vegetation inhibits the growth of less desirable species.

- **Target vegetation** includes trees or shrubs growing on and adjacent to BC Hydro corridors that are likely to grow into or fall onto overhead conductors or interfere with other maintenance activities. In some cases, vines must be controlled because they can climb utility poles and can severely reduce access to structures and create electrical hazards.

- **Hazard trees** have a defect or adverse environmental condition that increases their risk of failure, and can do damage if they fall onto a power line, electrical equipment, buildings, people, etc. Tree risk assessments are used to identify hazard trees and those with significant risk indicators are prioritized for removal to protect public and worker safety, property, and power system assets.

- **Noxious weeds or invasive plants** are introduced plants that can compete with or displace native species and disrupt natural ecosystems. Their need for control is outlined in the Provincial Invasive Species Strategy and the *Weed Control Act*.

Target vegetation and hazard trees are the primary focus of the vegetation management program to ensure a safe and reliable power system. BC Hydro also works with landholders to cooperatively manage and control noxious weeds or invasive plants where they are a concern.

Primary Target Vegetation

The following species represent the majority of target trees growing along the BC Hydro-managed power system; species will vary by region. In some areas of very low clearance, tall shrubs or bushes also must be controlled. Any plant that interferes with access to and maintenance of the power system will also be controlled, such as thorny bushes and vines. Many ornamental species are problematic when planted directly under or near the power lines because of their height or canopy width when they mature.

Most of the trees in Table 1 are native and common to B.C., but several are introduced or cultivated (e.g., black locust, catalpa, tulip tree, horse chestnut, London plane tree).

Table 1: Primary Target Species found along Power Lines in B.C.

Common Name	Scientific Name
Conifers	
Douglas-fir	*Pseudotsuga menziesii*
Western red cedar	*Thuja plicata*
Yellow cedar	*Chamaecyparis nootkatensis*
Pine	*Pinus spp.*
Spruce	*Picea spp.*
True fir	*Abies spp.*
Western Hemlock	*Tsuga heterophylla*
Larch	*Larix spp.*
Flowering Trees	
Alder	*Alnus spp.*
Birch	*Betula spp.*
Aspen	*Populus tremuloides*
Poplar/Cottonwood	*Populus spp.*
Maple	*Acer spp.*
Cherry	*Prunus spp.*
Willow	*Salix spp.*
Arbutus	*Arbutus menziesii*
Black Locust	*Robinia pseudoacacia*
Catalpa	*Catalpa spp.*
Tulip Tree	*Liriodendron tulipifera*
Horse Chestnut	*Aesculus hippocastanum*
Dogwood	*Cornus spp.*
Oak	*Quercus spp.*
Mountain Ash	*Sorbus spp.*
London Plane Tree	*Platanus acerifolia*
Hawthorn	*Crataegus spp.*

Monitoring Program, Section 58(2)(c)(i),(ii),(iii)

58 (2) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements:

(c) a description of the monitoring program that will be employed before or during the pesticide use for assessing pest populations, environmental conditions and damage caused by pests, which program must include a description of

(i) the monitoring methods,
(ii) the frequency of monitoring, and
(iii) the data that will be collected;

Monitoring of potential target vegetation through regular inspections and line patrols is an essential planning tool used to determine if vegetation maintenance is required, which control or combination of controls is needed, and the timing of maintenance to reduce the possibility of vegetation coming into contact with power lines.

Monitoring: is an activity in the IVM process where regular site inspections are used to determine whether treatments are necessary to meet site objectives, to identify the best timing for treatments, and post treatment to review and evaluate how the applied control methods are working.

BC Hydro monitors target vegetation, including hazard trees, on a regular basis. Urgent public safety or system integrity threats are dealt with immediately as corrective maintenance. Otherwise, inspections and patrols are used to develop and refine long-range and annual vegetation maintenance plans.

Biophysical Inventories

BC Hydro has extensive biophysical inventory information collected along its power line corridors. Information identified and collected includes:

- Vegetation Management Areas (VMAs; see below for definition)
- Streams and other bodies of water, and their characteristics
- Drinking water sources such as wells, points of diversion, and community watersheds
- Vegetation communities – biogeoclimactic zone, species density, percent coverage, growth rates, species composition, presence of noxious weeds, presence of threatened or endangered plants
- Conductor to ground clearances
- Terrain features, including degree of slope and aspect, eroded or erosion prone areas, and hazards such as large rocks and stumps
- Heritage information – archaeological sites, First Nations traditional uses
- Special conditions and features, such as compatible land use (agriculture, rangeland, recreation, berry picking), property encroachments, and other concerns

- Environmental conditions and features of the treatment area, such as riparian issues, wildlife issues, and other environmental concerns
- Access information, including roads, road surfaces, gates, locks, culverts, fords, helipads, etc.

All data collected is entered into a Geographic Information System (GIS) database that contains information related to vegetation management on corridors, including treatment history, patrol and inventory updates, site maps, prescriptions, environmental and consultation issues, landowner agreements, contracts, and so on.

Monitoring Method

The main monitoring method consists of aerial or ground patrols.

Patrols are inspections of the power line corridor to gather information within **Vegetation Management Areas (VMAs)**, which are defined as corridor segments or circuit blocks that have relatively uniform characteristics (e.g. vegetation, terrain, land use, etc.) and can be managed with the same long-term site objectives. This allows BC Hydro to track maintenance history and costs over time and to evaluate the effectiveness of the vegetation program so that the power system operates safely and reliably.

Frequency of Inspections

Distribution circuits are monitored on a cycle. The cycle is determined by species composition, projected growth rates, and clearance requirements (distance from energized electrical equipment) within the VMA. Typically, distribution VMAs are inspected every 3 to 5 years, a few months ahead of scheduled maintenance, in order to update the vegetation inventory used to define work, refine work timing and allocate budgets as necessary to maintain the required vegetation clearances to the conductors.

Transmission circuits are patrolled at least once per calendar year from end to end, with no more than 18 months elapsing between inspections as required by regulation. Because of the importance of transmission lines to the reliable operation of the power system and the rapid growth rates of some target species, most BC Hydro transmission circuits are patrolled twice per year, usually in the spring and fall.

Any outages or knowledge of poor conditions along a transmission or distribution corridor may also require additional patrols to identify and mitigate risk. Over time, BC Hydro has refined its patrol cycles based on local knowledge of the area, so it is known which areas need more frequent patrols or specific monitoring requirements. In addition to regular inspections, special patrols are conducted whenever there is a sustained outage to identify and address the cause.

Monitoring Information Collected

Information collected during inspections and considered when monitoring vegetation growth to determine work timing and method selection includes:

- Tree heights and proximity to limits of approach
- Imminent threats, e.g.., dead, dying, and leaning trees, root rot pockets (on the maintained corridor and along the edge)
- General condition of the danger tree strip adjacent to the maintained corridor
- Maintained width of the corridor in relation to the statutory ROW (narrowing or encroachments)
- Relative density of deciduous or coniferous target trees, expressed in percentage cover of the site
- Compatible vegetation that should be retained
- Fuel loading potential of the site and debris management required
- Damage to structures and lines
- Road access conditions, including gates, locks, road surface, culvert conditions, etc., and other factors that will dictate the types of equipment that can be brought onto the site
- Environmentally sensitive sites such those with rare and endangered species and riparian areas

This information is used to determine:

- Areas where vegetation management must be conducted, to help develop and execute the annual work plan
- Methods to be used in each of these identified areas
- Relative timing of the work during the treatment year
- Environmental or social issues that may impact work
- Hazard tree ratings
- Estimated work volume and equipment required to perform the work

Noxious Weeds

Noxious weeds are primarily monitored by regional weed committees and are entered into a database administered by the Province of BC.

Hazard Tree Inventories

Monitoring information is used to identify hazard trees on the BC Hydro system, which is a critical and ongoing activity. The criteria to be used for determining the hazard tree priority rating and to undertake a tree defect evaluation are based on type and severity of defect(s), tree species, and the location of the target tree. The power lines exist in a dynamic environment due to the continuous growth and decline of tall growing vegetation in and around the corridor. Thus the hazard tree inventory is updated regularly depending on the relative risks present on a corridor. Hazard trees in the inventory are systematically prioritized for removal based on their risk rating.

Action (Injury) Thresholds,
Section 58(2)(d)(i),(ii)

58 (2) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements:

(d) a description of the injury thresholds that will be applied in deciding whether a pesticide treatment is necessary and on explanation of

(i) how the thresholds were chosen, and
(ii) how the thresholds will be applied;

An **action threshold** (also called an injury threshold or hazard level) is used to determine when vegetation control becomes necessary, in order to ensure safety and minimize the risk of outages.

The **Action Threshold** is the point at which vegetation control on the power system becomes necessary to maintain public and worker safety and to minimize the risk of outages. Clearance limits to energized equipment are the primary basis for setting action thresholds, but incompatible plant species growth, height, density, location, condition, and control costs are also considered in determining the timing and selection of control methods.

BC Hydro controls tall-growing trees or vegetation that has the potential to reach or exceed the limits of approach to the line.

How Action Thresholds are Chosen

Clearance Requirements

To determine when vegetation must be controlled at a particular site, the following factors related to the clearance requirements for transmission or distribution power lines are evaluated:

- Limits of approach
- Maximum conductor sag
- Maximum conductor swing
- Mature vegetation height
- Growth rates of target species
- Unusual terrain features that may result in a low conductor to ground clearance

Lines can also be threatened by trees growing adjacent to the corridor. Therefore, another aspect in determining action thresholds is identifying and rating hazard trees along the corridor edges (the trees most likely to fall into the lines).

Limits of Approach

Limits of approach are the primary consideration for vegetation management work on power line corridors. However, work must also be practical, efficient, cost-effective, safe, and have minimal impact on the environment.

Limits of approach – The defined distance a person, machine, or conductive material (such as a tree) can be in relation to energized conductors based on the circuit voltage and **flashover** distance. Limits of approach are a key criterion for determining action thresholds in utility vegetation management programs. They are also used to set safe working limits for qualified or unqualified workers under WorkSafe BC Occupational Safety and Health (OSH) regulations and BC Hydro Safety Practice Regulations (SPRs).

Flashover: a disruptive electric discharge across an insulating medium such as an air gap, for example between vegetation and a high-voltage circuit. Electricity can flow across an air gap if vegetation is within close enough proximity. The trees do not have to be in direct physical contact with the energized equipment to cause an outage. The flashover distance depends on many variables, including the circuit voltage, altitude, air temperature, and relative humidity.

Other circuits attributes, such as designed maximum conductor sag and swing (from wind, snow/ice, and thermal loadings), are also considered in determining required clearances to vegetation.

Table 2 shows the limits of approach used as the basis for operational tree clearing on BC Hydro transmission lines. Operational clearances should ideally be achieved at all times. Actual site clearances take into account local conditions and the vegetation maintenance cycle. Where operational clearances cannot be achieved, mitigation plans are put into place in order to minimize system risks to ensure safety and reliability. Minimum vegetation clearance distances (MVCDs) are set by NERC for the high voltage grid and violation of these limits can pose serious risks to system reliability and are potentially subject to severe penalties for non-compliance.

Table 2: Limits of Approach and Operational Clearances to Vegetation for Transmission Circuits

	Limits of Approach					
Nominal Voltage, phase to phase	69kV	138kV	230kV	287kV	345kV and HVDC	500kV
Limits of approach for: 1) unqualified workers; 2) all uninsulated equipment	3.0m	4.5m	4.5m	6.0m	6.0m	6.0m

Table 3 shows general vegetation clearance specifications for distribution circuits, which can be modified to account for regional or local growth conditions.

On distribution corridors, the decision to initiate treatment of vegetation is based on the presence of target vegetation that has the potential to grow or fall into the lines and energized equipment. Growth rates of the target species determine the maintenance cycle and inspections identify the work necessary to maintain clearance to the distribution conductors through the duration of a given cycle. Clearances are achieved at the time of work to prevent flashover through to the end of the maintenance cycle, and to avoid sustained direct contact with the primary conductors resulting in a power outage.

Table 3: General Vegetation Clearance Specification on Distribution Circuits

Conifers	All Conductors
Overhead clearance	5.0 m
Side clearance	3.0 m field side and road side
Under clearance	To the ground
Deciduous/ Broadleaf Trees	All Conductors
Overhead clearance	5.0 m
Side clearance	5.0 m field side and road side
Under clearance	To the ground

BC Hydro also has extensive hazard tree programs on the transmission and distribution system to identify, monitor, and remove trees to mitigate fall-into risks.

How Action Thresholds Are Applied

Vegetation Management Cycles

Vegetation management is conducted on a cyclical basis. Maintenance schedules are determined for each area to be treated and optimized within Vegetation Management Areas (VMAs) to ensure appropriate and timely treatment.

The length of the vegetation management cycle on transmission lines will vary depending mostly on growth rates. Generally, the cycle ranges from 4–12 years. Areas that have very high growth rates or low clearance may require a shorter two or three-year cycle. Distribution cycles typically vary from 3 to 7 years around the province.

A number of other factors help determine the length of the management cycle, in particular, fuel loading on the transmission system. Within 300m of forested and grassland areas, Section 10 of the provincial *Wildfire Regulation* requires BC Hydro to maintain corridors in a manner that prevents any fire from spreading. Therefore, some areas may need to be managed before the target species grow too tall because they create too much biomass when cut.

Timing of Treatment

Once it has been determined that a particular site requires treatment, other concerns come into play to determine the specific timing. For example:

- Forest access may be closed due to fire hazard.
- There may be snow on the ground, preventing treatment.
- There may be closures around riparian areas due to fish windows, or around bird nesting areas during breeding season.

Treatment timing also depends on the control method used, as some treatments are more effective at different stages of the growth cycle. For instance, herbicide treatments are most effective when trees are actively growing and are often best used in combination with other treatment methods. An example of this is the use of herbicides to selectively treat deciduous targets a year or two after target high-density sites are mowed or brushed. Ensuring that herbicide applications are as effective as possible will help reduce the need for future herbicide use at a site.

Other Threshold Criteria

BC Hydro controls invasive plant species that could interfere with its other objectives for corridor vegetation management. In urban areas, aesthetics is a major objective and might preclude the presence of any vegetation except grass, shrubs, and low-growing ornamental species on corridors used as walking paths or other similar compatible use.

Weeds and trees also need to be controlled along access roads and helicopter landing pads adjacent to remote power lines, to ensure safe access and driving. Tree limbs hanging down into the access road or landing pad, and debris around roads and landing pads are managed. Vegetation around the base of woodpole structures is controlled to minimize the risk of fire.

Helipads

The BC Ministry of Transportation has stringent clearance requirements around helipad sites, where contact with trees or other vegetation could cause a fatal crash.

Helipads consist of a critical zone, secondary zone, and manoeuvering area. Vegetation management varies depending on the topography, terrain, and direction of helicopter approach. Low-growing grass, forbs, and shrubs are acceptable around helipad sites, except within the critical zone.

These sites must be kept clear of tall-growing vegetation for maintenance, access, emergency response, and safe helicopter landing.

The following types of vegetation are controlled around helipad sites:

- All vegetation within the critical helipad area (5m radius passenger and equipment exit zone)

- Trees and tall-growing vegetation within the secondary helipad area (15m x 15m area)
- Trees and tall-growing vegetation within the maneuvering area (generally 44m x 44m, but may vary depending on the terrain), if space is required to ensure rotor clearance and maneuvering room

Treatment Methods, Section 58(2)(e)

58 (2) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements:

(e) pest treatment options including

(i) a description of the pesticide and non-pesticide treatment methods of controlling pests that may be used,

(ii) the rationale for selecting the treatment methods described under subparagraph (i),

(iii) the benefits and limitations of each treatment method described under subparagraph (i), and

(iv) a description of how a decision to use treatment methods will be made.

IVM involves the use of different techniques to control undesirable vegetation.

Method Selection

A decision-making process for choosing treatment methods ensures that the most suitable, effective, and economical method or combination of methods is selected for an area to be treated, taking into account various assessment criteria. Specific techniques are not always appropriate for use in every region or situation.

Using criteria outlined below, BC Hydro evaluates the control methods that best suit the vegetation management site. The overall objective for a site and the prescription will guide the choices (see page 11, *Site Objectives*). The best methods are those that will meet the long-term site objective. Treatments are optimally timed for maximum efficacy, with consideration given to seasonal growing conditions, weather, and requirements for riparian areas, species at risk, and migratory birds.

Assessment Criteria

The treatment method chosen is justified and evaluated against the following assessment criteria:

Environmental, Social, and Economic Considerations

- Safety and reliability considerations

- Environmental sensitivities on the corridor and in surrounding areas
- Public and stakeholders
- Government requirements and considerations (federal, provincial, First Nations, and local government)
- Cost of treatment
- Labour and equipment resources
- Scope of the work
- Aesthetics

Effectiveness and Timing

- Consequences of not treating or delaying treatment
- Benefits vs. limitations of each method
- Efficacy
- Short vs. long term impacts
- Review of timing based on action thresholds
- Limits of approach
- Circuit criticality
- Condition based assessments including time since last treatment
- Debris management and fire risk mitigation
- Seasonal timing of treatment

Suitability for Site

- Site objectives
- Density of target stems
- Stem height and diameter
- Species (conifer/deciduous)
- Terrain (slope, aspect)
- Accessibility of the site
- Drinking water sources
- Riparian areas
- Biogeoclimatic zones and soil type
- Compatible and other land use
- Retention of compatible ground cover

Where herbicide use is considered for a site, additional assessment criteria include:

- Soil residual activity – activity of any herbicide residue present in the soil and rate of break down in the environment
- Mobility in soil and water of various herbicides
- Mode of action – the way in which the herbicide affects a plant
- Selectivity – the ability of some herbicides to affect specific types of vegetation while not having any impact on other plant species
- Toxicity – herbicides with low environmental/health impact to humans, fish and wildlife are selected.
- Timing –the effectiveness of many products depends on the growth stage of the plant

- Volatility is the tendency of a solid or liquid herbicide to vaporize; if enough vapours are released nearby compatible plants may be damaged
- Type of tree –
  - Coniferous trees generally do not require herbicides for control as long as the lowest whorl of branches can be removed.
  - Deciduous trees re-sprout and become more difficult and expensive to manage after repeated cuttings.
- Size of tree –
  - Small trees, often < 1.5m in height are best controlled by a foliar application of herbicides.
  - Larger trees are best controlled by basal applications such as stump treatment or stem treatment.
- Proximity to water/wells –
  - PFZs are set around water bodies to prevent herbicides from entering the area.
  - All label and regulatory directions are followed.
  - A few select herbicides are allowed close to water to control noxious weeds, but these must adhere to strict regulatory conditions for use.
- Use of land – herbicide use may be timed or technique modified to avoid berry/food/plant harvest

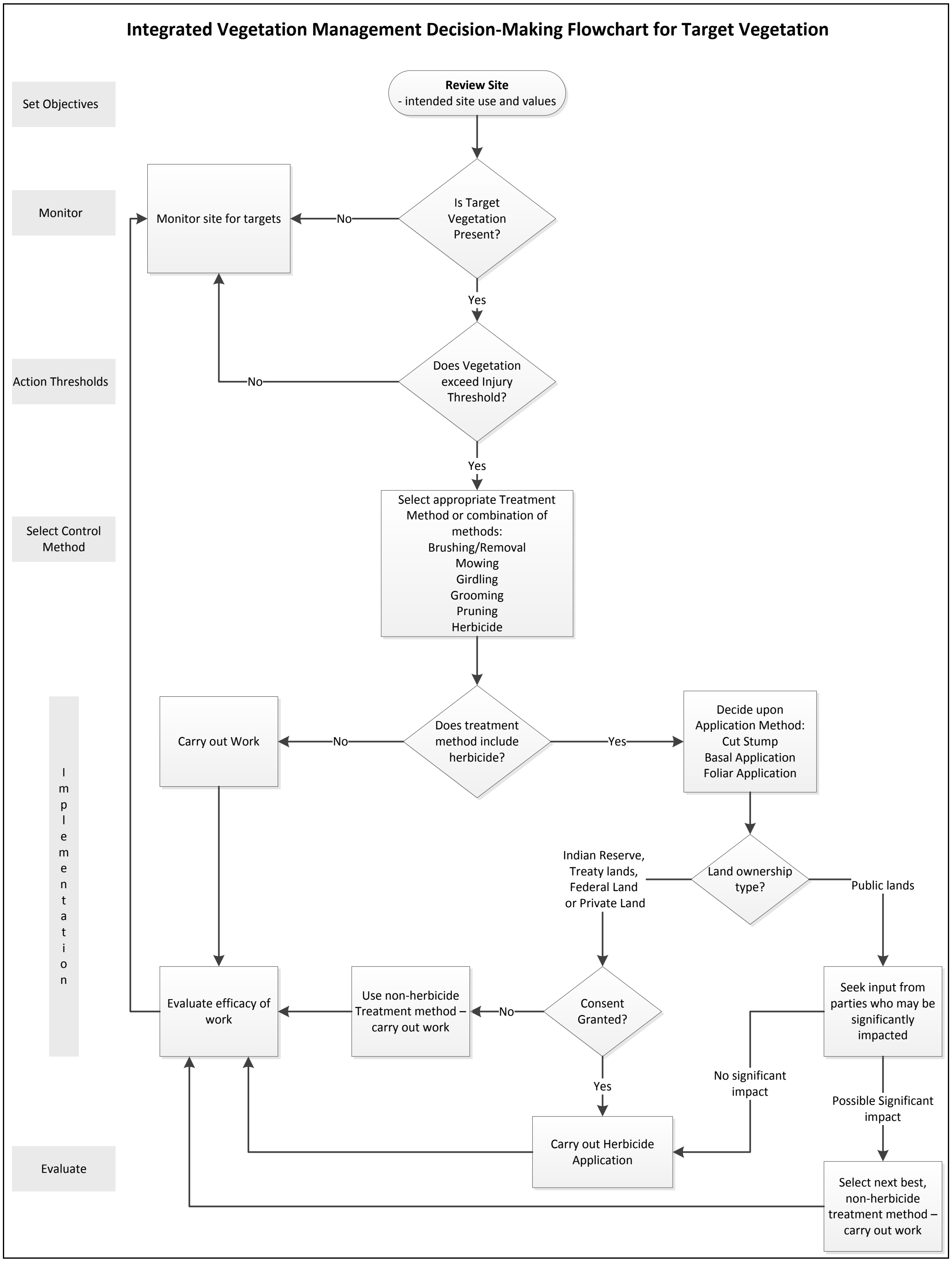
Health and Safety Characteristics

All herbicides used by BC Hydro have low to moderate toxicity. Applicators are well-trained and protected by personal safety equipment such as goggles, gloves, coveralls, and chemical-resistant boots based on the label recommendations. To minimize exposure, BC Hydro selects herbicides with the lowest level of toxicity to humans, fish and wildlife and uses application rates that provide acceptable levels of vegetation control. .

To minimize impacts to desirable vegetation in the treatment area and reduce the amount of herbicide used, the most suitable herbicide for the job is selected in consideration of application technique and equipment.

IVM Decision-making Flowchart

The following flowchart shows the decision-making process that personnel will follow when choosing a vegetation management technique.


Integrated Vegetation Management Decision-Making Flowchart for Target Vegetation
Set Objectives
Monitor
Action Thresholds
Select Control Method
Implementation
Evaluate
Review Site - intended site use and values
Is Target Vegetation Present?
No
Monitor site for targets
Yes
Does Vegetation exceed Injury Threshold?
No
Yes
Select appropriate Treatment Method or combination of methods: Brushing/Removal Mowing Girdling Grooming Pruning Herbicide
Does treatment method include herbicide?
No
Carry out Work
Yes
Decide upon Application Method: Cut Stump Basal Application Foliar Application
Land ownership type?
Indian Reserve, Treaty lands, Federal Land or Private Land
Public lands
Consent Granted?
No
Use non-herbicide Treatment method – carry out work
Evaluate efficacy of work
Yes
Carry out Herbicide Application
Seek input from parties who may be significantly impacted
No significant impact
Possible Significant impact
Select next best, non-herbicide treatment method – carry out work

The IVM control methods proposed for use on target vegetation on or adjacent to BC Hydro power line corridors include:

- Manual and mechanical (physical)
- Cultural (natural)
- Biological
- Chemical (herbicide) methods
- A combination of any of the above

The sections below describe the various vegetation management controls that BC Hydro uses on transmission and distribution corridors. It covers the:

- Description of the technique
- Selection criteria for control methods
- Benefits and limitations of each control technique

Manual and Mechanical Controls

BC Hydro will use the following manual and mechanical techniques for this IVMP:

- Brushing
- Mowing
- Grooming
- Girdling
- Pruning

Brushing

Brushing (also called slashing) is the removal by hand tools of individual stems of vegetation that will eventually grow into power lines. Stems are typically cut down as close to the ground as safely possible. In addition, a technique often employed in riparian areas may be used, which involves cutting taller trees at a higher height, then girdling the stem to prevent re-sprouting.

Brushing is the most commonly used manual vegetation management technique on transmission lines, and is sometimes combined with the herbicide cut-surface method to reduce sprouting of new shoots from the root system of broadleaf plants. Conifers when cut below the lowest green branch whorl will not regrow. Tools used in brushing include chainsaws or circular brush saws.

Generally, brushing is most effective when the target vegetation is more likely to die after being cut, for example in late summer dry periods after seasonal growth. Brushing can be highly selective and is usually directed only to target stems, preserving the maximum amount of low-growing compatible species.,. In addition, a tall brush/girdle method may be used, which involves cutting taller trees at a higher height, then girdling the stem to prevent re-sprouting. This technique is often employed in riparian areas or ditches around facilities.

Individual hazard trees that could fall onto the power lines are also removed by brushing. Although generally confined to corridors, brushing may extend beyond the corridor edge to improve long-term line security by removing trees that could fall onto the power lines from the edge. This is done in consultation with the landowner and usually performed where there is mutual benefit (e.g., rangeland use).

Selection Criteria for Brushing

Brushing is the preferred method in the following situations:

- In areas with a well-established low-growing plant community
- In combination with mowing
- In difficult terrain with limited machine access, e.g., around guy wires, steep slopes, and riparian areas
- When environmental risk over use of other methods is considered to be high

Brushing is not preferred in the following circumstances:

- Where target vegetation is present in high densities
- Areas where mowing is a suitable alternative
- Areas where slash debris would be unsightly or pose safety risks to humans, wildlife or grazing domestic animals
- Areas with a high fire risk if slash debris is left on site or where trees are of a size (generally >15 cm diameter) that when cut will leave debris levels that violate BC Hydro's fuel management standard or the *Wildfire Act.*

Benefits of Brushing

- Brushing allows the immediate removal of target vegetation with minimal disturbance to low-growing compatible species.
- Conifer trees cut below the lowest branch are permanently controlled.
- Brushing allows spot treatment with herbicides to prevent deciduous or broadleaf species from re-sprouting from the stump or roots.
- Brushing protects areas close to fish-bearing streams and other environmentally sensitive areas, since it can be done without causing excessive erosion or damage to the streambed.
- Brushing is beneficial in areas where target vegetation is widely scattered.

Limitations of Brushing

- Brushing is labour-intensive and can be dangerous to workers in steep terrain.
- Brushing is more difficult to carry out in dense vegetation.
- It can increase the fire risk if there is a buildup of debris (leaves, stems, etc.).
- In the absence of follow-up herbicide treatment, deciduous stumps can re-sprout repeatedly (into coppices) each time they are cut, resulting in dense thickets, increased growth rates, clearing costs, and shortened treatment cycles in subsequent years.

- Aesthetics of brushing may be a public concern due to the buildup of slash debris.
- Brushing leaves stumps, which can be hazardous to the public workers and grazing animals.

Mowing

Mowing is the cutting of target vegetation with wheel or track-mounted heavy-duty rotary or flail cutting machines. A heavy-duty tractor or excavator is equipped with the cutting head and driven over the corridor to cut target vegetation. This method is primarily used for transmission lines in conifer-prone areas and to reduce high-density deciduous areas. It is also used along distribution road side corridors in rural or uninhabited areas.

In some situations, machines such as a “Rolly chipper” or “feller buncher” may be used to cut down mature trees within or along the edge of the corridor in order to widen the existing ROW or remove hazard trees. If a logging operation is being conducted, BC Hydro follows all requirements as regulated by the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO).

Selection Criteria for Mowing

Mowing is the preferred method where the terrain allows, and in areas:

- With high densities of target trees
- With trees of a size that when cut will leave debris levels that violate BC Hydro's fuel management standard or the *Wildfire Act*

In general, mowing should not be used:

- On target trees of large diameter (mowing larger stems is impractical)
- Where low-growing compatible species are well-established and there are low stem densities of target vegetation
- In areas with rocks that can cause excessive damage to cutting heads
- In areas that are developed or have high public use because of the risk of flying debris
- In areas with stumps that create accessibility problems
- In boggy or wet areas where excessive rutting and soil compaction and damage could occur
- On slopes that create a worker safety hazard
- In riparian areas

Benefits of Mowing

- Mowing mulches the vegetation into smaller pieces that readily biodegrade, which reduces fuel loading and fire risks.
- Mowing is seasonally effective, inhibiting growth from spring through late summer. This is important in areas where herbicide follow-up treatment is not possible.

- In areas where fast-regenerating ground covers are plentiful, re-sprouting of unwanted vegetation is suppressed.
- In non-selective mowing and where little compatible vegetation exists, all vegetation is cut to ground, which may release compatible vegetation to grow and may facilitate future herbicide applications to control deciduous target regrowth
- In selective mowing directed only towards target vegetation, the utility corridor retains biodiversity and existing low ground cover.
- Target vegetation can be removed faster and more economically than other methods.
- Work progress and workmanship are clearly visible.
- Using machines is generally less hazardous to the operator than using hand-held equipment.

Limitations of Mowing

- Mowing is not generally suitable in riparian areas, and should not be used unless a site-specific riparian prescription has been produced and approved.
- Mowing can promote heavier regrowth of deciduous vegetation.
- Mowing is often limited by terrain, such as large rocks, stumps, and bodies of water.
- In wet terrain, machines cannot operate effectively and could damage the environment by causing soil compaction and rutting.
- Mowing mulches the brush using a high-speed rotary or flailing action, this can leave ragged stumps which may be unsightly, hazardous, and subject to public complaints.
- Mowing may result in rutting, track marks, or degradation of the ground surface.
- Mowing should not be used in areas where archaeological or cultural heritage sites are present to avoid disturbance.
- Mowing generally should not be used on slopes greater than 30% because most machines are unsafe to operate on steeper grades unless they are specially designed for such work.

Grooming

Grooming is the mechanical grubbing and grading of the corridor using excavators or bulldozers to remove all existing vegetation. The exposed soils are then seeded with grass or other low-growing species to prevent the growth of unwanted tall-growing species. Grooming is generally confined to areas with a high density of target vegetation, and is used to convert the site to one requiring little or no maintenance, e.g. rangelands. The advantage of grooming over mowing is that stumps are also removed. It may also be used in localized areas where individual stumps are grubbed out with a hoe in order to eliminate chronic regrowth of target vegetation and where herbicides cannot be used.

Grooming uses a combination of the following techniques:

- Mowing
- Machine-raking or brush-blading

- Ploughing or disking
- Rough grading / harrowing
- Seeding and fertilizing

Selection Criteria for Grooming

Grooming is an acceptable method in the following situations:

- To clear land for viable and sustainable grazing or agricultural use
- To re-contour the ground to increase the clearance to the conductor
- To create a shift to low-growing vegetation species in areas with a high density of target vegetation
- In response to requests of local government agencies or private property owners
- To maintain road access

In general, grooming should not be used:

- Where low-growing compatible species are well-established and there are low stem densities of target vegetation
- In areas with rocks that can cause excessive damage to clearing equipment
- In boggy or wet areas where excessive rutting and soil compaction and damage could occur
- On slopes that create a worker safety hazard
- In riparian areas
- In areas with archaeological or culturally sensitive sites that may be disturbed using mechanical equipment

Benefits of Grooming

- Grooming clears the site completely of vegetation and stumps, leaving it properly prepared for reseeding with desirable vegetation (i.e., to create new and enhanced habitat) or conversion to compatible use.
- Grooming and reseeding benefits the property owner by providing compatible use of the land base, such as for pasture or range land.
- BC Hydro benefits because of the reduced ongoing maintenance required under the power lines for electrical safety.
- Using heavy equipment is generally less hazardous to the operator than using hand-held equipment.

Limitations of Grooming

- Topography and soil conditions must be suitable for grazing or economic agricultural use, if the site is to be converted to this use.
- Grooming is only a temporary measure since it exposes bare soil, thereby opening the area for infiltration by unwanted species, including noxious or invasive weed species if not properly reseeded.
- Root-suckering species and re-sprouting species are not totally removed by grooming , thereby increasing multi-stemmed regeneration of unwanted species.

- Grooming leaves the soil temporarily exposed, resulting in possible erosion.

Girdling

Girdling (also called frilling) is a manual technique that involves cutting one or more strips of bark from around the entire tree trunk with a special cutting tool, saw or chain. The bark strips are removed along with other tissue down to the sapwood. This procedure is usually limited to single-stemmed, deciduous trees but can also be carried out on selected conifer trees when required.

After the bark has been severed, the tree is left to die. The above-ground parts continue to grow, but the roots starve and the tree slowly dies.

Only girdling and herbicide applications will kill deciduous species. They will re-sprout if mowed or slashed.

Selection Criteria for Girdling

Girdling is a preferred method in the following situations:

- In riparian areas or other environmentally-sensitive sites.
- Control of scattered individuals of alder, birch, and willow species.

In general, girdling should **not** be used:

- On trees of small diameter, since they may break at the girdle, causing the tree to re-sprout.
- On black cottonwood, balsam poplar and small-diameter aspen because of prolific re-sprouting.
- In areas where the target vegetation will reach limits of approach within two growing seasons, unless the tall brushing and girdling technique is used.
- For stem densities of over 15,000 stems per hectare because it is not practical or effective and is prohibitively expensive. Also, the amount of standing dead stems may create a fire hazard and when they fall impede access to people or wildlife.
- In situations where tree failure could lead to worker or public injury or property damage. In these cases, girdling may only be done via the tall brushing and girdling method.
- On conifers unless they are part of a riparian prescription or if the tree is retained as a wildlife tree.
- On maple species with coppices of more than five stems, or where the root collar is over half a metre in size. Maples this size will not be killed using girdling, as each stem would have to be cut and the tree may still re-sprout from the stump or roots.

Benefits of Girdling

- Girdling promotes retention of vegetation cover and increased site stability due to root structure retention. For this reason, it is useful in riparian areas or where slope stability may be an issue.
- Girdling is not usually limited by difficult terrain.

- Girdling is flexible, because individual stems and species can be removed or left on a tree-by-tree basis.
- Girdling increases low-growing forage vegetation for wildlife and habitat for small mammals and birds. There is no danger to wildlife.
- Deciduous over story is removed naturally over several years, giving conifers and low-growing understory time to adjust to new environmental conditions.

Limitations of Girdling

- Girdling cannot be used effectively over large areas or in dense brush, because it becomes too laborious and costly.
- Close inspection and careful work are required to ensure adequate depth and width of the girdles is maintained.
- Tools are not effective on large stems with thick bark.
- If stems have many live branches below breast height (1.3m above ground), additional work with hand tools is required to remove the branches.
- The dead trees remain standing for 2–3 years, which may be objectionable in highly visible areas.
- The use of hand tools may be hazardous to workers.
- Blowdown of dead trees may pose a safety problem alongside well-travelled areas, or to workers re-entering the area.
- Workers must be experienced girdlers, since poor girdling results in re-sprouts or premature blowdown with regrowth.

Pruning

Pruning is the removal of branches or limbs in order to direct and control tree growth away from power lines. The term pruning generally implies the use of proper arboricultural practices. It is not trimming, which refers to the cutting back of vegetation to a uniform distance; and it is not topping, which refers to cutting tree limbs back to a stub, bud, or a lateral branch. BC Hydro strongly promotes the concept of planting “the right tree in the right place” to have safe and compatible vegetation near power lines that does not require repetitive pruning.

Pruning is the approved vegetation management method for areas where tree removal is not an acceptable option. It is the most common control method on much of the distribution system and on some lower voltage transmission lines, particularly in urban or built up areas or where circuits are situated along road allowances that permit the use of bucket trucks. In most instances, BC Hydro does not support pruning trees on higher voltage transmission lines because of the clearances that must be maintained between the lines and the trees and because most high-voltage transmission lines run cross country making it difficult to safely climb and prune trees.

In general, distribution circuits (<35 kV) and lower voltage transmission circuits (69kV and 138kV) have corridors narrow enough that edge trees will require pruning to maintain safe clearances.

Selection Criteria for Pruning

Pruning may be the best management technique in the following circumstances:

- Where it is cost-effective compared to tree removal
- Where there is significant public opposition to tree removal, and there is no legal right-of-way agreement
- Where the main stem is outside the right-of-way but has branches growing from the side toward the conductors
- Where trees are required for wildlife habitat or to protect riparian areas
- Where a stable, healthy, treed edge is adjacent to the power lines and only needs side pruning to maintain clearances

Pruning should not be used in the following situations:

- Where the tree trunk is too close to the power line to safely leave it in place and the tree needs to be topped or severely cut to maintain clearance
- Where the tree is in declining health and should be removed or replaced with more suitable vegetation.
- Where the cost to maintain the tree exceeds the cost of removal.

Benefits of Pruning

- Trees are not removed and still provide aesthetic and other functions.
- Pruning influences the direction of branch growth so that trees can be directed away from conductors.
- Pruning can minimize adverse effects on tree health, and over time, reduce line clearing workload and risk from unhealthy trees.
- A pruned tree provides wildlife habitat.

Limitations of Pruning

- Pruning is usually costlier than removal because trees need to be pruned repeatedly.
- Pruning must be performed by a Certified Utility Arborist (CUA), a skilled experienced operator, because of the proximity of vegetation to the conductors. CUAs are specially trained to work safely near energized lines and have specialized equipment to perform their work safely.
- Improper pruning techniques can seriously damage trees and result in unhealthy, unsightly, or hazardous trees that may require off-cycle remedial work.
- Pruned trees remain in proximity to power lines and have hazard potential, while removed trees do not.

Cultural/ Natural Control

Cultural control is where vegetation is managed in a way that precludes the growth of incompatible target species through the use of crops, pastures, parks, or other managed landscapes. Conversion of corridor segments from stands of tall-growing target vegetation to rangeland, agricultural crops, or other compatible uses such as parks with suitable low-growing vegetation are all forms of cultural control. Required equipment may include cyclone spreaders, belly grinders, seed drills, and hydro-seeding machines to establish low-maintenance grassy areas.

In other areas, the landscape may be managed to encourage the establishment of native low-growing plant species adapted to the site so that the growth of tall, target vegetation is eliminated or suppressed. Where appropriate, BC Hydro actively encourages the establishment of suitable low-growing vegetation to replace tall-growing species. This is sometimes called natural control.

Selection Criteria for Cultural/Natural Control

Where plant competition is feasible on a power line corridor, manual, mechanical, and chemical control techniques that enhance compatible vegetation are carefully selected to prepare the site for conversion to culturally managed sites.

Cultural/natural control may be a favoured management method in the following circumstances:

- Replanting with appropriate, low-growing vegetation can be an effective vegetation management technique, particularly in small areas with high public exposure, or in riparian habitats or shelterbelts.
- Where the corridor is suitable to compatible use such as cropping, rangeland, nurseries, or parkland and is consistent with adjacent land use.
- Where the compatible land use is actively managed by others, usually privately owned lands or lands managed actively by a government agency – provincial, local, First Nations, etc.

Cultural control may not be feasible in the following situations:

- Where it would be difficult to maintain plantings
- Where suitable nursery or seed stock may be hard to source or be prohibitively expensive

Benefits of Cultural/Natural Control

- The corridor is managed in a way that enables multiple uses that are compatible with the power system and provides multiple resource values over a long period.
- When land is effectively converted to compatible cultivated or natural cover, it effectively suppresses the growth of tall, incompatible vegetation or reduces its volume, making it easier to maintain the power line corridor with reduced frequency or magnitude of disturbance.
- It may be used to manage complex riparian sites or areas with unstable slopes, using bioengineering techniques with living plants or a combination of plants and structural materials that help prevent erosion (e.g., hydroseeding, grass seeding, live staking, or wattles).
- It may have initial higher costs to convert an area but may have lower long-term costs through reduced ongoing maintenance.

Limitations of Cultural/Natural Control

- Lack of available appropriate sites for conversion (e.g., Christmas tree farms may only be suitable on high-voltage transmission ROWs with sufficient clearance to make the venture feasible)
- High cost or inability to have others manage the site over the long-term, resulting in abandonment of the initiative
- Difficulty in establishing and maintaining suitable crops or cover and the risk of increasing undesirable vegetation (tall-growing targets or noxious/invasive weeds) through site disturbance

Biological Control

Biological control is the reduction or suppression of unwanted organisms by introducing or enhancing the presence of natural enemies. It is often used in noxious weed or invasive plant control by introducing insects that selectively control specific weeds but do not damage other vegetation. The insect species attack the target weed plants either by slowly killing it, or by reducing seed production and plant vigour.

With respect to utility vegetation management and control of tall-growing vegetation, there is currently a fungus that has been used as a biological control agent for some woody broadleaf species. There are no insects currently available which control woody target species.

The fungus, *Chondrostereum purpureum, (Chontrol)* is a registered biological agent used to control target deciduous trees and shrubs. This fungus is a primary invader of wounded deciduous trees. It works over a period of one to two years by slowly killing the tree and shrub. Under the right conditions, it can effectively control deciduous trees that are prone to re-sprouting. It is applied to cut stumps in a paste formulation. Biological control may be used in utility vegetation management:

- On noxious weed species known to have an effective biocontrol agent.
- Using registered biocontrol agents which are non-toxic to humans and animals and can be used near bodies of water or other environmentally sensitive sites.

Biological control may **not** be feasible in the following situations:

- Where conditions are not favourable to the introduction or survival of the biocontrol agent, which limits its ability to effectively control the target vegetation
- Where no suitable biocontrol agent exists for the vegetation species being managed. Currently, limited biocontrol agents are available for utility vegetation management.

Benefits of Biological Control

- May provide very selective control of problem vegetation, especially some species of noxious weeds

- Low impact to the environment as it creates less site disturbance unlike any other manual, mechanical, or cultural control method and some herbicide application techniques
- It helps to reduce the spread of undesirable vegetation
- It may reduce vegetation densities to a manageable level

Limitations of Biological Control

- The very specific nature of the organisms that are registered and available for use
- The limited amount of species and areas that can be controlled using this method
- Labour-intensive technique that requires very specific site conditions for effective application (timing, weather, temperature, etc.)
- Use restrictions in some cases where economic crops (e.g. orchards) are present in proximity to the area requiring control
- It is not usually effective in eliminating vegetation populations

The introduction of insect biocontrol agents on power line corridors for noxious weed control may limit options for the control of tall-growing vegetation targets, so sites must be carefully chosen and recorded. This method is only used at larger sites with a high density of noxious weeds or invasive plants, such as fields or areas with adjacent properties where there is a cooperative effort to control vegetation. The size of the vegetation stand must be large enough to support the insect population, and the site itself must be suitable habitat for the insect species. This type of program is generally employed with the cooperation and guidance of an expert from Agriculture Canada.

Biological control may become move viable as an increased number of biological agents become available. However, research of new biocontrol agents is very time consuming and expensive and it takes years to determine if a potential agent is promising or effective and has no impacts on non-target species. The registration and regulation of biocontrol agents is an involved process to get a new product to market. BC Hydro will monitor any products that become available and add them to the list of vegetation management techniques, where appropriate and operationally feasible.

Chemical (Herbicide) Control

This section describes the various herbicide techniques that BC Hydro uses on power line corridors to control vegetation. It covers:

- Cut surface
- Basal bark
- Backpack foliar
- Mechanized foliar
- Injection techniques

Cut Surface

This control method (also called cut-and-treat) is used in conjunction with brushing or tree removal in deciduous stands. The tree is cut as low as possible to the ground, and herbicide is applied to the cut surface of the stump to limit re-sprouting.

Cut surface is a directed technique, which reduces the impact on non-target species. It also minimizes herbicide use and optimizes natural control.

The current herbicide of choice for cut surface treatments is triclopyr. Glyphosate is preferred in environmentally-sensitive areas, and imazapyr on dense clumps of hard-to-control species such as bigleaf maple.

Selection Criteria for Cut Surface Treatment

- Cut surface treatment is used in areas where basal bark treatment is not optimal, such as where standing dead trees are an aesthetic concern (e.g., alongside roadways), or in low conductor-to-ground situations.
- Cut surface treatment is highly effective on most species that do not sucker from their roots.

Benefits of Cut Surface

- Cut surface treatment can be used in any terrain.
- No standing dead foliage remains, making this technique desirable in highly visible areas.
- There is minimal risk of herbicide exposure to workers or the public due to the directed nature of the treatment.
- Herbicide is limited to the stump surface, resulting in minimal impact on fish, wildlife, or the environment.
- It removes the canopy, but increases low-growing forage for wildlife.

Limitations of Cut Surface

- Improper application can result in unsuccessful treatment, and may require re-application of the herbicide.
- Treatment results in reduced forage and cover in the short term.
- It is a labour-intensive method and not cost-effective for dense stands.

Basal Bark

Basal bark treatment involves applying herbicide onto the bark of the target tree. The herbicide penetrates the bark into the cambium layer and diffuses throughout the tree and the roots, to prevent re-sprouting. It is applied with a low-volume backpack or hand-held sprayers with a positive shut-off system.

Selection Criteria for Basal Bark Treatment

- The method is best used on small deciduous trees under about 4m in height.

- At very high stem densities, basal treatment may not be practical, effective, or cost-effective. Also, the amount of standing dead stems may create a fire hazard.

Benefits of Basal Bark

- It is less labour-intensive than manual brushing and girdling.
- It is suitable for remote or difficult-to-access areas.
- It treats only targeted individual stems and so is appropriate for areas with low densities of target trees.
- It removes the canopy over a three-year period, allowing a low-growing plant community to establish.
- The potential for spray drift is reduced.
- There is minimal risk of herbicide exposure to workers or the public due to the targeted nature of the treatment.
- A small amount of product is applied per hectare.

Limitations of Basal Bark

- Dead foliage may be objectionable.
- In areas of low clearance, surviving treated stems may continue to grow.

Backpack Foliar

Backpack foliar treatment sprays herbicides onto the foliage of individual trees or small clusters of trees and tall growing shrubs or invasive plants, using a manually-operated, low-volume, pressurized backpack with a positive shut-off system.

Selection Criteria for Backpack Foliar Treatment

- The terrain must have good foot access to reduce the risk of tripping and falling by applicators.
- If target vegetation is below 1.5m in height, it allows for better coverage, and will reduce the potential for operators to overreach.
- It is often used to treat re-sprouts one to two years after the area has been mowed or slashed.
- It is the main treatment used for noxious and invasive weed control.

Benefits of Backpack Foliar

- Backpack foliar is the most efficient method for managing the re-sprouts of high-density target vegetation and for controlling noxious weeds
- It targets specific vegetation, with adjustable application rates and dosages.

Limitations of Backpack Foliar

- Buffer zones may be required to protect PFZs (see page 61), depending on wind direction and topography.
- Applicators should not treat foliage above their heads for safety which limits the height of target vegetation that can be suitably treated

- Caution must be exercised to avoid treating areas where desirable species may be affected.
- There may be a short-term decrease in vegetation forage species.

Mechanized Foliar

This treatment method uses a fixed nozzle, boom-directed nozzle or wick sprayer mounted on a vehicle such as a skidder or an ATV, to spray herbicides onto the foliage of target trees.

Selection Criteria for Mechanized Foliar Treatment

- This method is optimally used on areas that have been previously mowed or hand-slashed to reduce re-sprouts of target species and has minimal compatible vegetation present.
- It is recommended for use when there is a high density of target cover at a uniform height. This will reduce the potential for spray runoff to the ground.
- It is an excellent treatment for noxious and invasive weed control.

Benefits of Mechanized Foliar

- Mechanized foliar is an efficient method for managing the re-sprouts of high-density target vegetation.
- It targets specific vegetation, with adjustable application rates and dosages.
- Nozzles can reduce the amount of herbicide used because well-defined droplets are produced, resulting in good coverage of the foliage with limited runoff.

Limitations of Mechanized Foliar

- It is not as selective as backpack foliar application.
- There is more potential for drift than a backpack foliar application.
- Buffer zones may be required to protect PFZs (see page 61), depending on wind direction and topography.
- Caution must be exercised to avoid treating areas where desirable species may be affected.
- There may be a short-term decrease in vegetation forage species.
- Mechanized foliar is often limited by terrain, such as steep slopes, large rocks, stumps, and bodies of water.
- In wet terrain, machines cannot operate effectively.
- Mechanized foliar may result in rutting, track marks, or degradation of the ROW surface.
- It should not be used on slopes greater than 30% because most machines are unsafe to operate on steeper terrain.

Injection

Injection techniques used include mechanical injection, hack-and-squirt or syringe application where permitted based on a herbicide product label. In mechanical injection, a small capsule containing herbicide is injected into the stem of the target tree or stump by means of a battery-powered drill or automatic loading lance. The herbicide is slowly released into the sapwood. Syringe applicators have been effectively used to inject herbicide into stems of invasive species such as Japanese knotweed. Hack-and-squirt uses a small axe, machete, or hatchet to cut through the thick bark and into the sapwood. Herbicide is then squirted into the cut with a bottle.

Selection Criteria for Injection Techniques

- An injection technique can be used when the cut surface method cannot be done.
- It should not be used when there is a near-term risk to line security because the trees do not die immediately.
- It is effective on re-sprouting stumps, provided the capsules are applied to live tissue.
- It can be used in areas of limited access.
- It may also be a good choice around riparian areas where permitted.
- Larger-diameter trees are not effectively controlled by injection, but can be controlled by hack-and-squirt
- It is not effective on bigleaf maple or aspen poplar.
- Blowdown of dead trees may pose a safety problem alongside well-travelled areas, or to workers re-entering the area.

Benefits of Injection Techniques

- Injection techniques are highly selective and injury to surrounding species is uncommon.
- It is effective on certain species, such as red alder, and for larger trees that cannot be managed with basal applications. It has also proven to be effective on large stemmed noxious weed species.
- It is not limited by terrain.
- It is easily learned and safe for the applicator.
- Herbicide use is minimal and self-contained. The potential for worker and public exposure is virtually eliminated.
- It virtually eliminates the possibility of environmental contamination because it is so directed (although shell casings may be left onsite in capsule injection).
- It removes the canopy, but increases low-growing forage for wildlife.
- It can be done at any time during the year on woody targets.

Limitations of Injection Techniques

- In highly visible areas, dead foliage of standing trees may be objectionable.
- Capsules are not bio-degradable.
- There is more risk of line security being compromised because trees continue to grow after treatment, and trees may be occasionally missed for treatment.
- Injection methods are very labour intensive
- Capsules are not readily available.

Evaluation,
Section 58(2)(f)

A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following integrated pest management elements:

58 (2) (f) a description of the monitoring program that will be employed for evaluating the effectiveness of the pesticide use on pest populations and the environment, including effects on organisms other than targeted pests, by comparison with the information collected under the program described in paragraph (c), which program must include a description of

(i) the monitoring methods,
(ii) the frequency of monitoring, and
(iii) the data that will be collected.

BC Hydro carries out comprehensive evaluations to ensure effectiveness of its vegetation management program. It includes:

- **Contract inspections** – As work projects are carried out, site inspections are performed to ensure proper procedures and work specifications are followed.
- **Post-treatment evaluations** – These include quality assurance assessments and audits to ensure program objectives are met.
- **Continuous improvement** – New techniques and products are identified and incorporated where appropriate.

After vegetation management work has been completed at a site, information is collected to evaluate and measure the treatment results against the planned site objectives.

The purpose of evaluating vegetation management work is to:

- Achieve site objectives
- Assess program effectiveness and adjust work plans accordingly
- Determine the success/efficacy of treatment techniques
- Ensure no negative environmental impacts occurred
- Take corrective action where necessary

The treatment method used is deemed effective if it resulted in the overall reduction of tall-growing target vegetation and the promotion of low-growing, stable, non-target plant communities to prevent grow-into outages and minimize fall-into outages for a safe and secure power system.

Evaluation of the site also adheres to Section 35(2) of the IPMR, which requires that records of treatment results, effectiveness, and impacts be kept. Evaluation results are used to revise site prescriptions and to provide the basis for improvements and changes to the vegetation management process.

Evaluation Methods of Herbicide Applications

Evaluations of herbicide applications are visual in nature and are typically conducted on the ground. The exact timing and procedure will depend on the treatment methods used, the geographic area, the type and condition of the site, the vegetation being controlled, and the season. All areas treated with herbicide are evaluated, but not 100% of each treatment area. BC Hydro takes reasonable efforts to ensure that sites are evaluated within one year of the treatment.

Evaluation results are used to revise site prescriptions and to provide the basis for improvements and changes to the program. BC Hydro considers the following in evaluation of any herbicide applications:

- Effectiveness of the herbicide treatment in controlling the target vegetation
- Need for follow-up treatments
- Amount of herbicide used
- Need to adjust application rate
- Any impact of the herbicide application on non-target species
- Whether the technique was the most appropriate one for the job
- Incidental impacts to non-target species
- Cost-effectiveness of the treatment program

Data Collected and Frequency of Evaluation

During contract inspections, herbicide treatment sites are reviewed for accuracy of application and the following data is collected:

- Cut surface – Look for marker dye on stumps.
- Basal – Look at the stem to ensure a proper wrap was made.
- Foliar – Check for droplet coverage on leaves and for foliar decline (wilting, browning).
- Injection – Check the number and placement of cuts, capsules, drills, and plugs.

Incidental treatment of non-target species is identified by looking for signs of spray on vegetation compatible with power lines. In addition, buffer zones and PFZs are checked for signs of spray drift.

Within a year after application and during regularly scheduled patrols, the site is evaluated for target mortality to ensure that program objectives were met.

Data collected during evaluations consists of qualitative and quantitative observations of mortality of targeted vegetation. These observations are documented by photographs, field notes, or representative sample plot measurements.

Research

To ensure the most up to date research, tools, and techniques for vegetation management are considered and incorporated into both operational and strategic vegetation plans, BC Hydro works in conjunction with:

- Integrated Vegetation Management Association of BC (IVMA)
- Integrated Species Council of BC (ISCBC)
- International Association of Arborists (ISA)
- Utility Arborists Association (UAA)
- FP Innovations
- And others

In addition, information is reviewed on an ongoing basis to ensure new and potentially better control methods or herbicide products are used where possible.

Chapter 3, Herbicide Use and Handling

This section covers the responsible use and handling of herbicides, as per Section 58 of the IPMR (information required for Pest Management Plans). It includes:

- Transportation — Section 58(3)(a)(i)
- Storage — Section 58(3)(a)(ii)
- Mixing, Loading and Applying Herbicides — Section 58(3)(a)(iii)
- Disposal — Section 58(3)(a)(iv)
- Spill response plan — Section 58(3)(a)(v)
- Pre-treatment inspection procedures – Section 58(3)(b)(iv)
- Equipment maintenance and Calibration — Section 58(3)(b)(v)
- Weather monitoring – Section 58(3)(b)(vi)
- Herbicides Used and Application Methods – Section 58(3) (c)

Responsible Use of Pesticides

The careful, limited use of herbicides is an important and necessary part of vegetation management on power line corridors. When herbicides must be used, BC Hydro takes all reasonable precautions to ensure they are used safely and responsibly.

There are many ways in which BC Hydro reduces the impact of herbicides, for example, by using the least amount possible to achieve expected outcomes, and ensuring that applications are conducted properly by qualified personnel. By including herbicides in an integrated pest management program, target vegetation can be reduced to a level that allows for a longer period of time between management cycles and an overall reduction in tall growing, target species.

Requirements for Certified Applicator

Any individual or company (i.e., a Contractor) that provides a service to BC Hydro by applying commercial or industrial herbicide must have a valid B.C. Pesticide User Service License.

Herbicide applications are to be performed or supervised by an individual who holds a current Certified Pesticide Applicator's Certificate in the Industrial Vegetation and Noxious Weed Control or Forestry General or Forestry Non-Broadcast categories. The name and certificate numbers of the applicator(s) who will supervise the work must be recorded on the Daily Operations Record (DOR).

The Certified Pesticide Applicator must, as per the IPMR:

- Be in continuous attendance at the work site while herbicides are being applied
- Supervise no more than four uncertified individuals at one time
- Maintain continuous contact, auditory and/or visual, with each uncertified individual being supervised
- Be within 500m of persons being supervised
- Have proof of certification at or near the treatment location so it is readily available for inspection during herbicide use (if possible, the certificate should be kept at the mix site, in the vehicle used by an application crew during a treatment, or on the applicator's person at all times, such as in a wallet or pocket; the certificate can be a copy to avoid loss or damage of the original)
- Comply with requirements set out in Division 7 of the IPMR, Records and Reporting Requirements

Herbicide Transportation, Section 58(3)(a)(i)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *A description of the methods of handling, preparing, mixing, applying and otherwise using pesticides that will be employed under the plan including a description of the following procedures:*
>
> *(i) procedures for safely transporting pesticides;*

Personnel must adhere to the following legal requirements for the transportation of herbicides, as per the IPMR:

- Ensure that the herbicide is properly secured during transport to prevent accidental discharge or unauthorized removal, and to prevent contamination of food or drink intended for animal or human consumption, household furnishings, toiletries, clothing, bedding, or similar items transported with the herbicide.
- Keep herbicides in their original containers and with original packaging and labelling affixed, or in appropriate containers with trade name, name of active ingredient, concentration of active ingredient, and pesticide registration number affixed.

In addition to the IPMR, BC Hydro requires personnel to:

- Follow all applicable federal and provincial transport requirements set out in the *Transportation of Dangerous Goods Act*, including requirements for documentation, labels, markings, and placards. Spray equipment containing more than 5,000 liters cannot be taken onto public roads.

- Persons transporting dangerous goods must hold a valid TDG Certificate of Training or be under the direct supervision of someone who is trained and certified.
- Read and understand the product label and Material Safety Data Sheet outlining the transportation requirements for each regulated product used by BC Hydro.
- Keep in the vehicle a first aid kit, fire extinguisher, spill contingency plan, and spill contingency kit (with WorkSafe BC regulated contents). Vehicle operators must be trained to handle spills.
- Inspect containers for defects prior to transport. Transfer any defective packages to empty pesticide containers of the same type, or secure any defective containers into secondary containment vessels for transportation.

Herbicide Storage, Section 58(3)(a)(ii)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

(a) a description of the methods of handling, preparing, mixing, applying and otherwise using pesticides that will be employed under the plan including a description of the following procedures:

(ii) procedures for safely storing pesticides;

Storage facilities may be permanent, temporary, or mobile. Building materials must be fire-resistant wherever possible and facilities must be clean and well-marked.

Personnel will follow these instructions to store herbicides as per the IPMR requirements:

- Keep herbicides in their original containers and with original packaging, or in appropriate containers with trade name, name of active ingredient, concentration of active ingredient, and pesticide registration number affixed.
- Store herbicides separately from food intended for human consumption.
- Keep herbicides in storage facilities that are locked when unattended, not used for storage of food intended for human or animal consumption, ventilated to the outside, and accessible only to authorized persons.
- Mark storage facility in block letters: "WARNING: CHEMICAL STORAGE – AUTHORIZED PERSONS ONLY" so signs are visible to persons approaching each door providing access to the facility.
- Store fumigants and other pesticides that release vapours or bear a poison symbol on the label in a storage facility that is not attached to or within a building used for living accommodations
- Within 60 days after starting to store an herbicide at a location, provide notice of the storage location to the fire department closest to that location.

In addition to the IPMR, BC Hydro requires personnel to:

- Keep storage facilities separate from work and living areas, and away from flammable materials, and bodies of water.
- Keep a herbicide inventory log book, current product labels, Material Safety Data Sheets, and a copy of WorkSafe BC's *Occupational Health & Safety Regulation* at the storage facility.
- Keep at the storage facility a first aid kit, fire extinguisher, Spill Response Contingency Plan, and a spill kit with WorkSafe BC regulated contents. Persons storing herbicides must be trained to handle spills.

Mixing/Loading & Applying Herbicides, Section 58(3)(a)(iii)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

(a) A description of the methods of handling, preparing, mixing, applying and otherwise using pesticides that will be employed under the plan including a description of the following procedures:

(iii) procedures for safely mixing, loading and applying pesticides;

Mixing and Loading Herbicides

Personnel will follow these instructions to mix and load herbicides as per the IPMR requirements:

- Do not wash or submerge in a body of water any container used to prepare, mix, or apply herbicides.
- When drawing water from a body of water or an irrigation system into a container for herbicide use, maintain a gap between the herbicide and the equipment to prevent herbicide from entering the body of water or irrigation system.

In addition to the IPMR*,* BC Hydro requires personnel to:

- Before mixing, read the product label and Material Safety Data Sheet, and follow all safety precautions
- Ensure that persons mixing or loading herbicides are Certified Pesticide Applicators, and will use proper protective equipment and clothing as recommended on the label
- Ensure that emergency wash facilities, first aid equipment, spill kits spill response plans, and emergency phone numbers are close at hand.
- Use clean water free of any suspended particles. Use appropriate procedures to prevent backflow of herbicides into the water source.
- Conduct mixing and loading in areas selected to prevent any spilled herbicides from entering the PFZs for bodies of water, wells, and water intakes.

- Mix herbicides in well-ventilated areas outdoors, under low wind conditions. Ensure there is adequate light and stand upwind to avoid contaminating yourself.
- Keep containers well below eye level to prevent splashing or spilling herbicides in the face or eyes.

Applying Herbicides

As required by the IPMR during work, personnel must:

- Not exceed the area of treatment areas specified on the Notice of Intent to Treat.
- Take precautions to ensure that domestic water sources, agricultural water sources, and soil used for agricultural crop production are protected for their intended use.
- Take precautions to prevent unprotected human exposure to herbicides.
- Take precautions to avoid applying herbicides over vertebrate wildlife or domestic animals that are visible to the user.

In addition to the IPMR, BC Hydro requires personnel to:

- Follow directions and restrictions on product labels and Material Safety data sheets.
- Record and/or map any changes to the original treatment plan.
- Use the most practical, suitable, target-specific application techniques, such as low-volume, low-pressure backpack or hand-held sprayers and wick applicators.
- Whenever possible, apply herbicides when target species are at their most susceptible stage.
- Have appropriate maps and prescriptions on site.
- Refer any complaints to the BC Hydro representative.

Herbicide Disposal,
Section 58(3)(a)(iv)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(a) A description of the methods of handling, preparing, mixing, applying and otherwise using pesticides that will be employed under the plan including a description of the following procedures:*
>
> > *(iv) procedures for the safe disposal of empty pesticide containers and unused pesticides;*

The disposal of herbicide waste is governed in British Columbia by the *Environmental Management Act* and *Hazardous Waste Regulation*.

Personnel will follow these instructions to dispose of herbicides:

- Plan all applications carefully to minimize excess and waste. Any leftover herbicide mix should be saved for future use or disposed of in an appropriate manner.
- Triple-rinse empty metal, glass, or plastic containers before disposal. Rinse sprayers and containers well away from any body of water or well.
- Puncture or break any non-recyclable containers so that they cannot be reused, then discard at an approved sanitary landfill.

Spill Response Plan, Section 58(3)(a)(v)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(a) A description of the methods of handling, preparing, mixing, applying and otherwise using pesticides that will be employed under the plan including a description of the following procedures:*
>
> > *(v) procedures for responding to pesticide spills;*

Personnel must ensure that an appropriate spill containment kit and spill contingency plan is at the application site. If an herbicide spill occurs, personnel will follow these instructions:

- Ensure the safety of workers and public by limiting access to the area, protecting people from exposure, and ensuring wash facilities are nearby.
- Put on protective equipment before cleaning up the spill, including protective clothing, respirators, and eye protection.
- Contain the spill.
- Report spills to the Provincial Emergency Program (PEP) as per the *Spill Reporting Regulation*. Also follow reporting protocols to BC Hydro.
- Clean up the site.

Pre-treatment Inspection Procedures, Section 58(3)(b)(iv)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:*
>
> > *(iv) pre-treatment inspection procedures for identifying treatment area boundaries;*

Before vegetation management is conducted at a specific site, a pre-treatment inspection is completed to ensure that environmentally-sensitive areas are protected. At this stage, the work method is confirmed to ensure it is appropriate for the site, and specific environmental concerns are identified and reviewed with vegetation contractors prior to beginning work. Before work begins, environmentally-sensitive areas are marked in the field. On transmission corridors, the active ROW boundary is also flagged.

Before Work Starts

When treating areas of Crown land with herbicide, BC Hydro will seek input from parties who may be significantly impacted. On private land or First Nations treaty lands or reserves, BC Hydro will obtain permission from the owner or manager of the land before treating with herbicides.

Personnel must ensure that the work area is properly defined and inspected before work begins as required by the IPMR:

- Check the Notice of Intent to Treat to ensure that the proposed treatment locations, the proposed treatment (including the herbicide and its method of application), and the total area of the treatment areas are correct.
- Ensure that the herbicide used is registered for the intended use as described on the herbicide label.
- Keep onsite the detailed map showing the proposed treatment areas and PFZs in the work area.
- If work is being conducted in an area where biological control agents have been released to control noxious weeds, make reasonable efforts to identify these sites and prevent harm to these organisms.

Before herbicide applications begin, personnel must ensure that each individual who will be using the herbicide is informed of:

- Boundaries of the treatment area
- Requirements for personal protection, including Material Safety Data Sheets
- Herbicide use procedures required to protect human health and the environment
- Target species to be controlled, the desirable species to be protected during treatments, and how to identify these plants/trees

Signs

The IPMR requires that notification signs be posted on land being treated with herbicides. Signs must be clearly visible and legible from each approach to the treatment area used by the public. All approaches from highways are posted. Signs may not be removed for at least 14 days after the herbicides have been applied. Records are kept on how public notification was given and where notices were posted.

The signs must include information on the trade name or active ingredient of the herbicide used, date and time of application, precautions to be taken to prevent harm to people entering the treatment area, the PMP confirmation number, and contact information.

Equipment Maintenance & Calibration,
Section 58(3)(b)(v)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:

(v) procedures for maintaining and calibrating pesticide application equipment;

Equipment Maintenance

The IPMR requires applicators to ensure that all equipment is in good working order and if required is calibrated to conform to the application rates on the herbicide label.

In addition to the IPMR, BC Hydro requires that:

- Equipment must meet all regulatory requirements.
- Equipment must be safe, clean, in good repair, and compatible and appropriate for the herbicide being used.
- Nozzles must be working properly or be replaced, and hose connections must not be leaking.
- Tools and equipment must be in good working order and properly cared for and stored.
- Tools that are prone to failure must be replaced, and spares must be available onsite.
- A regular maintenance schedule must be implemented for each piece of equipment.

Equipment Calibration

Application equipment must be properly calibrated to conform with the application rates on the herbicide label.

As a minimum, all sprayers should be calibrated once per year prior to use, and at regular intervals throughout the season when changing pesticide products and when nozzle output begins to vary. The frequency of calibration is dictated by factors such as the formulation of herbicides used. For example, abrasive formulations will result in greater nozzle wear and will require more frequent calibrations.

In general, equipment should be calibrated:

- For each individual applicator using hand-held or backpack equipment
- At the beginning of each season
- At the start of each treatment job
- More frequently with abrasive formulations (such as wettable powders)

- If application rates are questionable
- Any time the application equipment type is changed, such as a change in size or type of nozzle
- Any time the pesticide or formulation of a pesticide is changed

It is not necessary to calibrate every back pack, provided each back pack has the same set up with nozzles etc.

Calibration Records

As per the IPMR requirements, personnel must keep a record for each piece of application equipment that requires calibration, when the equipment was calibrated, and the data upon which the calibration was based.

Weather Monitoring,
Section 58(3)(b)(vi)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:*
>
> > *(vi) procedures for monitoring weather conditions and strategies for modifying pesticide application methods for different weather conditions;*

Personnel will monitor weather and weather forecasts at the beginning and on a daily basis wherever herbicides are applied. Information is collected from Environment Canada and other official sources.

The prevailing meteorological conditions including temperature, precipitation, and velocity and direction of wind, are recorded for each treatment location and each day of use on the Daily Operations Record (DOR).

Stop Work Conditions

Herbicide applications must be stopped when any of the following conditions exist in the contract area. When herbicide label restrictions are more limiting, they will take precedence over the conditions below:

- Temperatures exceeding label requirements
- Raining steadily (water running consistently down the lateral stems)
- Ground wind speed exceeds 8km an hour (for foliar applications), i.e., gentle breeze, leaves, and twigs in constant motion
- Foliage is covered by ice or frost, or water is flowing on the foliage
- Overall conditions that favor herbicide drift

Residual pesticides must not be used on water-saturated soil, during heavy rainfall, or if heavy rainfall is imminent.

Herbicides must be applied only between 30 minutes before sunrise and 30 minutes after sunset.

Drift Monitoring Procedures

Three factors contribute to drift: application techniques, weather conditions, and applicator error. The possibility of drift is reduced through appropriate training and certification of workers, and by not conducting foliar applications in ground winds over 8km/h. Also, thickeners can be added to the herbicide to increase droplet size.

Spray drift is monitored during foliar applications of herbicide to help ensure the accuracy of buffer zone establishment, and the integrity of PFZs.

Herbicides Used and Application Methods, Section 58(3)(c)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(c) identification of each pesticide that will be used under the plan, the manner of its application and the type of equipment required for each manner of application.*

Chemical control involves the use of herbicides to inhibit growth of vegetation on or adjacent to BC Hydro power line corridors. Herbicides are an important tool in integrated vegetation management.

As per the definitions in the IPMR:

Pesticide – means a micro-organism or material that is represented, sold, used or intended to be used to prevent, destroy, repel or mitigate a pest, and includes:

- A plant growth regulator, plant defoliator, or plant desiccant
- A control product as defined in the *Pest Control Products Act (Canada)*
- A substance that is classified as a pesticide by regulation, but does not include micro-organisms, materials, substances, or control products excluded from this definition by regulation

The following herbicides are used according to the methods and application equipment in Table 4. (Some of the herbicides are described in more detail below, and application methods are described further in the next section and in chapter 2.)

- aminocyclopyrachlor
- aminopyralid
- clopyralid
- *Chondrostereum purpureum*
- dicamba

- diflufenzopyr
- fluroxypyr
- glyphosate
- imazapyr
- metsulfuron-methyl
- picloram
- triclopyr
- 2,4-D

Some herbicide products may have the identical active ingredient but a different trade name and a different pesticide control product (PCP) number issued by the federal Pest Management Regulatory Agency (PMRA). These herbicides are considered equivalent and can be used under this IVMP.

Types of herbicide application equipment that may be used include:

Backpack – A backpack is a portable, manually operated, pressurized container with a nozzle for spraying herbicides. It operates under low pressure, thus minimizing the possibility of drift. Backpack sprayers may be used for selective herbicide applications or for spraying individual trees or plants. Backpack sprayers are not effective for large, continuous areas requiring vegetation control due to problems with effective patterns and overspray or underspray. Directed spray from a backpack unit will selectively control targeted weeds. Backpack spray is effective on established, low-density species, tree seedlings, and noxious weeds. Within this PMP, backpack sprayers may be used for applying all of the herbicides proposed for use by foliar or soil application

Mechanized foliar – Boom sprayers are widely available commercially for ATV and agricultural tractor equipment. They use a solution tank and spray apparatus similar to a powerhose sprayer, except that solution is delivered to nozzles mounted at designated intervals along the boom length.

Powerhose – A hand-held spray gun and hose attached to a portable tank with a motorized pump system filled with herbicide and mounted on a truck will selectively control a variety of vegetation with directed spray. Its use, effectiveness, and disadvantages are similar to the backpack, except that a spray gun is not as mobile or as convenient to use. However, spray guns are efficient for larger scale applications unless restricted by terrain. This equipment can be used for the application of all herbicide liquid mixtures.

Wick – Wick applicators are used to selectively apply herbicide by wiping it directly onto plants. Wicks are made of rope or absorbent pads. The wick applicators are available in many sizes, from hand-operated to vehicle mounted. Only small amounts of herbicide are applied, so the need for pumps, control devices, and spray tanks is eliminated. Applications using this technique are very labour-intensive. Wipe-on wick application is ideal for areas where no spray drift can be tolerated.

Squirt bottle – A squirt bottle refers to a hand-held, non-pressurized container, usually plastic. It may have a trigger pump sprayer. It is used to spray a solution of low-toxicity herbicides directly onto foliage or tree stumps

Injection tools – battery-powered drill or automatic lance used to inject capsules of herbicide into stems or stump of a target tree; this can also include a syringe type applicator where permitted according to the product label.

Brush bar with herbicide – a brush saw or chainsaw with an attachment that deposits the herbicide on the spinning blade or chain, and automatically applies the herbicide onto the stump when cutting the stem

Table 4: Herbicide Method and Equipment

Manner of Application	Active Ingredient	Equipment Required
Foliar	aminocyclopyrachlor	Backpack sprayer Boom sprayer Powerhose Wick
	aminopyralid	
	clopyralid	
	dicamba	
	diflufenzopyr	
	fluroxypyr	
	glyphosate	
	imazapyr	
	metsulfuron-methyl	
	picloram	
	triclopyr	
	2,4-D	
Cut stump	*Chondrostereum purpureum*	Backpack sprayer Spray bottle Squirt bottle Modified brush saw
	glyphosate	
	imazapyr	
	picloram	
	triclopyr	
	2,4-D	
Basal bark	glyphosate	Backpack sprayer Spray bottle
	triclopyr	
Injection	glyphosate	Injection lance
	triclopyr	
	imazapyr	
Frilling/hack-and-squirt	glyphosate	Backpack sprayer Spray bottle Squirt bottle

Main Products Used

The following herbicide products are the most frequently used on power line corridors. They are effective on deciduous trees that will resprout after cutting which are the main target species for control. In addition, BC Hydro has many years of experience in the application of these herbicides. This allows application crews to refine the treatment to specific site conditions increasing efficacy and reducing the impact on non- target species.

Glyphosate –Vantage, Vision, or Equivalent

This herbicide is effective for controlling re-sprouts of most deciduous tree species. It is applied to the cut stump surface of the woody vegetation immediately after brushing, or injected/squirted into the cut frill of a tree as a liquid formulation. It can also be used in a broadcast application. Glyphosate is non-selective and has no or very little residual activity in the soil. It binds tightly to all types of soils independent of the levels of organic matter, silt, clay, and soil pH. Given its non-selectivity, glyphosate use on BC Hydro power line corridors has been largely replaced in recent years by the use of triclopyr.

Triclopyr – Garlon Products or Equivalent

The active ingredient triclopyr is effective for control of deciduous trees and brush. It provides an effective alternative to glyphosate for control of certain tree species, such as aspen poplar and trembling aspen. Triclopyr is a selective herbicide, has very little soil residual activity, and rapidly degrades in soil microorganisms and sunlight. It generally takes 10-46 days to break down in soil depending on soil type, moisture, and temperature. Although the herbicide does not bind to soil as tightly as glyphosate, once triclopyr moves into the soil, there is generally little movement. The herbicide tends to stay in the upper 30 cm of the surface soil layers following rainfall where it undergoes degradation. Garlon products can be applied as cut stump, basal, or foliar applications.

Specialized Products

The following herbicide products are used in specific situations such as the control of certain species of noxious weeds. Some products are new on the market and BC Hydro is slowly introducing them into the program. Finally, BC Hydro has a number of active ingredients available for use in order to reduce the development of resistant plant populations, which can occur when one active ingredient is used over a period of time.

Aminocyclopyrachlor and Metsulfuron–methyl - Navius or equivalent

This is a selective, low-toxicity herbicide that provides pre- and post-emergent control of broadleaved weeds, woody species, vines, and grasses on several non-food use sites, such as rights-of-way, wildlife management areas, recreational areas, turf/lawns, golf courses, and sod farms. The chemical is a systemic herbicide and acts by disrupting gene expression. This causes undifferentiated cell division and elongation. The herbicide can cause damage to specific conifer species such as spruce and pines.

Aminopyralid – Milestone or Equivalent

This herbicide is a selective, post-emergent herbicide that controls a wide spectrum of broadleaf weeds, including Canada thistle, knapweeds, oxeye daisy, scentless chamomile, and many others. This herbicide is mildly residual, and uses reduced application rates to minimize herbicide load on the environment.

Aminopyralid and Metsulfuron-methyl – ClearView or Equivalent

ClearView combines two active ingredients (aminopyralid and metsulfuron methyl) to produce a selective, post-emergent herbicide that controls a broad spectrum of broadleaf annual and perennial weeds, including Canada thistle, knapweeds, oxeye daisy, scentless chamomile, and many others. This herbicide can be applied for 12-24 months of good control, and uses reduced application rates.

Aminopyralid, Metsulfuron-methyl and Fluroxypyr – Sightline or Equivalent

The combination of three active ingredients allow this herbicide to effectively control broadleaf weeds, invasive plants, and shrubs on rangeland, pasture, non-crop areas, industrial sites and rights-of-way. Difficult to control invasive species such as kochia, including glyphosate-resistant biotypes, are successfully managed with this combination of active ingredients.

Aminopyralid, Metsulfuron-methyl and Triclopyr – ClearView Brush or Equivalent

ClearView Brush combines the above listed active ingredients (from Clearview) with triclopyr, which results in broad-spectrum control of hard to control woody species, shrubs, and broadleaf and invasive species. This product is relatively new and represents the move to reduced risk chemistries that offer a safe profile for environment, wildlife, and adjacent vegetation when used as per the label.

Chondrostereum purpureum – Chontrol or Equivalent

This product is a fungal organism that slows or stops the re-growth or suckering of targeted plants. It is best applied during September/October and provides best results in areas with a high concentration of alder and other deciduous woody species that it is labelled for.

Clopyralid – Lontrel or Equivalent

This herbicide is useful for spot-treatment control of broadleaf noxious weed species. It is preferred over picloram for the control of some noxious weeds such as Canada thistle, perennial sow-thistle, and scentless chamomile. It is effective only on actively-growing plants in areas where high-residual herbicides should not be used. For perennial weeds, clopyralid will control the initial top growth and inhibit regrowth during the season of application. Clopyralid is not used as a soil-applied residual herbicide, and will not be used in areas of high rainfall.

Diflufenzopyr and Dicamba – Distinct, Overdrive, or Equivalent

This herbicide is the first active ingredient from a chemical class called semicarbazones. Based on available data, diflufenzopyr has low toxicity to humans, birds, aquatic organisms, mammals, and bees. It has low residual properties. Diflufenzopyr causes hormones in plants to become concentrated in the growth regions. These products generally target broadleaved weeds.

Imazapyr – Arsenal Powerline or Equivalent

This herbicide is used to control brush species, most broadleaf weeds and annual and perennial grasses. It is applied as a low volume foliar or cut stump application. This herbicide is translocated throughout the plant and plant growth stops almost immediately after application. It is moderately residual and can usually provide season-long control on many perennial plants.

Metsulfuron-methyl – Escort or Equivalent

The active ingredient (metsulfuron-methyl) is used as a selective herbicide to control various species of broadleaf weeds, trees, and brush and some annual grasses. It stops cell division in the shoots and roots of the plant, causing plants to die. It is applied pre-and post-emergence (before and after growth begins). The herbicide has low to very low toxicity to humans and animals. Best results are obtained when this product is applied to actively-growing weeds during late spring to autumn.

Picloram and 2-4,D – Aspect or Equivalent

The combination of Picloram and 2,4-D results in the targeted control of woody plants as well as broadleaf weeds, while still being safe for grasses. Picloram is a selective, residual herbicide that can remain in the soil for several years providing long-term control against susceptible broadleaf invasive plants. Since picloram may persist in the soil, care is taken to avoid applying this herbicide to areas where soil may be moved or where there is shallow aquifers or domestic water intakes and wells.

2-4,D – LV 700 or Equivalent

2,4-D compounds are hormone mimic chemicals that are selective depending upon rate and species. It is formulated to rapidly penetrate the waxy covering of plants. It is of low toxicity to humans and animals; however, waterbodies should always be protected. The most common application is foliar, and for best results should be applied when plants have rapid growth, likely May/June and September. 2,4-D herbicides have a short soil persistence period.

Chapter 4, Environmental Protection

This chapter covers the following, as per Section 58 of the IPMR (information required for Pest Management Plans):

- Protecting community watersheds and water sources – Section 58(3)(b)(i)
- Protecting fish, wildlife, and habitat – Section 58(3)(b)(ii)
- Preventing contamination of food – Section 58(3)(b)(iii)

Protecting Watersheds and Water Sources, Section 58(3)(b)(i)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:

(i) strategies to protect community watersheds and other domestic and agricultural water sources from adverse effects of pesticide use;

Pesticide free zones (PFZs) are maintained around community watershed intakes, as well as other water intakes and wells used for domestic and agricultural purposes. The locations of these water sources are noted and all PFZs are flagged before any herbicide treatment takes place. See Table 5, Water Protection Table

Pesticide free zone (PFZ) – is an area of land that must not be treated with pesticides, and must be protected from pesticides moving onto it. PFZs usually are a strip of land adjacent to water bodies to protect riparian habitat. Required PFZ widths are specified in the herbicide product label or by provincial regulation and are usually a minimum of 10 m in width as measured by the horizontal distance from the high water mark. PFZs are marked in the field before starting any herbicide treatment.

Measures to Protect Community Watersheds

Many communities have designated watersheds where surface water is managed as the water source for the community. The location of **community watersheds** to be protected is verified by checking the Community Watershed website of the BC Ministry of Environment.

Community watershed — a water source from a stream where the water is used for human consumption; the stream is licensed under the provincial *Water Act* for a waterworks purpose or a domestic purpose controlled by a water user's community, and the drainage area is not more than 500 square kilometres.

No herbicides are mixed, loaded, or applied within:

- 10 metres of bodies of water within community watersheds
- 30 metres downslope of community watershed intakes
- 100 metres upslope of community watershed intakes

These PFZs are measured and flagged in the field prior to treatment.

Measures to Protect Wells and Water Intakes

In many BC communities, homeowners use private groundwater or surface water sources for domestic water, instead of a watershed. BC Hydro is restricted from applying herbicides within defined PFZs and **No Treatment Zones** (NTZs) set out in Table 5: Water Protection Table (below). PFZs and NTZs are used to protect water supply intakes or wells used for domestic and agricultural purposes that are located on or adjacent to power line corridors. Locations of registered wells and intakes are verified by searching applicable government websites.

No treatment zone (NTZ) – an area of land that must not be treated with pesticides.

Attempts to identify and located unregistered wells and water intakes are made by:

- Identifying potential water users, such as private property owners or lessees, and asking them about intake and well locations.
- Looking onsite for domestic or agricultural water use

Protecting Fish and Wildlife, Riparian Areas, and Wildlife Habitat,

Section 58(3)(b)(ii)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:

(ii) strategies to protect fish and wildlife, riparian areas and wildlife habitat from adverse effects of pesticide use;

Bodies of water are provided protection through the IPMA and IPMR. BC Hydro ensures that herbicides will not be applied within established NTZs, and will respect PFZs and special requirements set out in buffer zones.

Body of water – Any natural body of water, including lakes and streams, etc. It does not include a human-made, self-contained body or structure for water.

Buffer zone – A strip of land between a PFZ and the pesticide treatment area where pesticides are not applied directly in order to prevent stray drift, runoff, or leachate into the PFZ. The width of the buffer zone is variable and up to the discretion of the applicator, taking into consideration the application equipment used and site factors such as terrain, soil conditions, and weather conditions.

In addition to the PFZs specified earlier for bodies of water, BC Hydro will exercise caution when working with herbicides adjacent to and within sensitive ecosystems including riparian habitat.

Riparian habitat – The area of land adjacent to a body of water that contains vegetation that is distinctly different from the vegetation of adjacent upland areas due to the presence of water. Riparian vegetation has several important ecological functions including providing shading or cover, water temperature regulation, food for fish and wildlife (small organic debris), bank stability, or stream structure (large organic debris).

Work in riparian areas is carefully planned in advance through an inventory and prescription process. Fish and riparian habitat is protected as follows:

- Identifying and mapping bodies of water through applicable sources of government data
- Documenting bodies of water identified during field assessments in BC Hydro's mapping system
- Classifying bodies of water as fish-bearing or non-fish-bearing (bodies of water that cannot be confirmed as fish-bearing are managed as fish-bearing)
- Managing fish-bearing bodies of water with appropriate PFZs and NTZs as per Table 5

Measures to Protect Fish and Riparian Areas

These general precautions are followed when working around bodies of water:

- Applicators will adhere to the PFZs in Table 5.
- Treatment methods are directed only to target vegetation. As much vegetation as possible is retained around bodies of water.
- Herbicide use will not remove vegetation that is needed to:
  - Prevent erosion of a stream bank
  - Prevent debris that would cause an unreasonable adverse impact from entering the stream

  - Maintain slope stability in areas where landslides have occurred
- Trees are directionally felled away from stream banks and shorelines to minimize disturbance to the riparian area.
- No deleterious substances are allowed to enter the watercourse, including fuels, debris, sawdust, herbicide products, or sediment.
- Where required, machine-free zones are established around riparian areas.
- Equipment or vehicles will not be washed at a stream or along the shores of any body of water.
- No power equipment or vehicles are serviced or refueled any closer than 15m from a body of water. (Note: This distance may need to be greater depending on site-specific conditions.)
- Watercourses will not be diverted, blocked, or restricted, except temporarily to correct hazardous situations, or in an emergency.
- Machinery should only cross streams over a bridge or culvert. If there is no bridge or culvert available, only one crossing point is selected and used, at a location where adverse effects can be minimized and mitigated.

Water Protection Table (Table 5)

The following distances for NTZs and PFZs are prescribed by the IPMR. Section numbers are listed in the first column.

In order to maintain PFZs as pesticide-free, an adequate buffer zone must be implemented around the PFZ. This zone must account for sloped topography, weather at the time of treatment, or any other site factor that could cause the spread of the pesticides.

To establish NTZs and PFZ's, BC Hydro measures the distance between the point of application of herbicide and the water source. This means the horizontal distance from the **high water mark** of the body of water, **stream**, dry stream, or classified **wetland**. If the high water mark cannot be reliably identified (as in the case of puddles or small pools or water), it is measured from the level of the water.

Stream – A watercourse that contains water on a perennial or seasonal basis, is scoured by water, or contains observable deposits of mineral alluvium, and which has a continuous channel bed that is 100m or more in length, or flows directly into a fish stream or a fish-bearing lake or wetland, or a licensed waterworks.

Wetland – A swamp, marsh, bog, or other similar area that supports natural vegetation, and which is distinct from adjacent upland areas.

High water mark – The highest area of land frequently wetted during a season of high water, i.e., the edge of the body of water at its highest wet point, usually marked by a break in terrestrial vegetation

Table 5: Water Protection Table

Section of IVMP Reg.	Permitted Application	NTZ/PFZ	Notes
All Herbicide Applications			
71(3) Reg.	Domestic and agricultural wells and water intakes, including all methods and pesticides.	30m NTZ	NTZ may be reduced if reasonably satisfied that a smaller NTZ will ensure no pesticide enters well or intake (70(4) Reg.)
Glyphosate Applications			
74(1)(a)(ii)	Along or around a body of water or classified wetland that: • is fish-bearing, or • that drains directly into a fish-bearing body of water, or • is along or around a dry stream that when wet is fish bearing or • drains directly into a fish bearing body of water	2m PFZ	Glyphosate must be applied using **selective application methods**.*
74(1)(c) Reg.	Along or around a body of water if the body of water is: • not fish-bearing at any time of the year • does not drain directly into a fish-bearing body of water	2m NTZ	
74(1)(b) Reg.	Along or around a body of water or a classified wetland that is: • fish-bearing, or • that drains directly into a fish-bearing body of water, or • along or around a dry stream that when wet is fish-bearing or drains directly into a fish-bearing body of water	5m PFZ	
74(2) Reg.	Up to the high water mark of a temporary free-standing body of water and dry stream, that is: • not fish-bearing at any time of the year • does not drain directly into a fish-bearing body of water	0m NTZ	
Non-glyphosate Applications			
73(1) Reg.	Around or along a body of water or dry stream and classified wetland using any pesticide except glyphosate, subject to label restrictions and including all application methods.	10m PFZ	Except for glyphosate applications.
Noxious Weed and Invasive Plant Management			
77(2) Reg.	Targeted application of glyphosate to noxious weeds and invasive plants if the application is used between 1m and 10m above the high water mark	1m PFZ	

*__Selective application__ – The application of a pesticide to individual plants so that the vegetation between individual plants is not treated. For the purposes of BC Hydro's Pest Management Plan this includes cut surface, basal bark, directed foliar, and injection treatments.

Wildlife and Wildlife Habitat

Information is collected from the Conservation Data Centre on locations of rare and endangered species. Areas of known critical **wildlife habitat** are identified within the BC Hydro geographic information system. The provincial *Wildlife Act* and the federal *Species at Risk Act* must be adhered to. Where critical habitat has been mapped and a recovery plan is in place, there is communication with the recovery team to ensure activities meet the strategy requirements. In cases where treatment areas potentially intersect with protected habitats, required protection measures are prescribed.

Wildlife habitat – Any natural environment in which a species or group of species lives; those of particular concern are areas managed or protected by provincial or federal legislation.

Herbicides used in the vegetation management program have no known unreasonable adverse effects on fish and wildlife when applied according to the product label.

When power line corridors are converted to a stable low-growing plant community, it provides potential habitat for wildlife including ungulates and nesting birds. However, removal of tall-growing vegetation may result in the loss of habitat for some species that require mature forested areas.

Wildlife and habitat are protected as follows:

- Identify and protect wildlife trees.
- Leave a diversity of low-growing shrubs and plants that can be browsed by wildlife or used for habitat, including along the edges of ROWs.
- Do not use herbicides in or around known mineral licks.
- Ensure that herbicide use is directed only at target vegetation.
- Keep animal trails open and clear of cut brush.
- Do not disturb inhabited raptor and heron nests.
- Minimize soil erosion caused by vegetation management activities to reduce impact on desirable plants or wildlife.
- Control noxious weeds (as designated under the *Weed Control Act).*
- Take precautions to avoid the use of herbicides near vertebrate wildlife or domestic animals that are visible to the user.

Protecting Bees

- In general, herbicides are NOT harmful to honeybees and other pollinating insects when applied according to label instructions.
- Herbicides are often applied to vegetation that is not a forage source of honeybees and wild bees, and/or spraying is taking place outside the blooming period.
- Most tree species controlled by BC Hydro are wind pollinated (e.g. alder, aspen, birch, cottonwood, willow), not insect pollinated (e.g. arbutus, cherry, some maple species).
- In cases where bee forage plants are sprayed, the herbicide(s) most often have a repellency effect on foraging bees.
- Within a short time after spraying, the plants will be affected and wilting and discoloration will quickly deter foraging bees to visit.
- Most herbicides are liquid sprays that will cause rapid absorption and evaporation. Wettable Powders (WP) may pose a risk when bees are tempted to collect the powdery residue of the pesticides left on the foliage and flowers but these formulations are not commonly used by BC Hydro.

Preventing Contamination of Food, Section 58(3)(b)(iii)

58 (3) A pest management plan prepared for the purpose of section 7 (1) (a) of the Act must include the following operational information:

> *(b) a description of the environmental protection strategies and procedures that will be followed under the plan, including a description of the following strategies and procedures:*
>
> > *(iii) strategies to prevent pesticide contamination of food intended for human consumption;*

In general, food plants and medicinal plants are low-growing shrubs and herbaceous plants that are compatible with power line safety and reliability. The establishment of these species is encouraged and they are not actively controlled. However, tall-growing species and other vegetation that might interfere with power lines must be controlled regardless of their use by people.

Public notification of herbicide treatments is posted at the treatment area according to the IPMR, Section 64. BC Hydro will also notify landowners or users who have previously requested such notification. These measures help ensure that people can recognize an area that has recently been treated and can avoid inadvertently gathering food in the vicinity until the appropriate wait time noted on the posting has passed.

Areas used to collect food and medicinal plants are mapped where BC Hydro is notified of their ongoing use, and these interests are considered when planning vegetation management work.

BC Hydro does apply herbicides to areas used for agricultural crop production without permission of the land owner.

In the vicinity of certified organic farms, the grower is responsible for maintaining an 8m buffer zone between their organic crops and power poles (as recommended by the Certified Organic Associations of British Columbia, CAN/CGSB-32.310-200 5.1.7). During the pre-treatment planning, identified organic farms are contacted to ensure they are aware of required buffer zones.

COVID-19 Emergency Response and Wildfires Mitigation Plans

Attachment 6

Distribution Operating Order 1D-51

BC HYDRO

T&D SYSTEM OPERATIONS

DISTRIBUTION OPERATING ORDER 1D–51

DISTRIBUTION SUBSTATION FEEDER RECLOSING POLICY

Supersedes 1D-51 issued 12 April 2019

Effective Date: 08 October 2019

Review Year: 2023

APPROVED BY: *Original signed by*

Doug Pochailo
System Control Manager
Real Time Operations

Denotes Revision

1.0 GENERAL

This operating order outlines the policy and procedures for manual, supervisory and automatic reclosing and re-energizing of a distribution circuit by a substation recloser or relay following a forced outage.

The attached Appendix indicates which circuits can be reclosed, and which cannot be reclosed. In general, reclosing is not permitted on circuits with one or more of the following attributes:

- Circuit is 100% comprised of underground cable.
- Requested by customer on dedicated circuit.
- Circuit is a Stand By circuit without customer load.

Operating Order References

- 2T-24 Substation Reclosers with Electronic Controls
- 1D-15 LLP and ANRP Request for Downstream Distribution System - Procedure for Requests and Blocking/Returning Reclosers
- 1T-18 Live Line Permits, Assurance of No Reclose Permits and Caution tags
- 1D-51 Distribution Substation Feeder Reclosing Policy (35 kV and Below)
- 1D-07 Authorized Changes to Recloser Control Status
- 1D-03 Field Reclosers
- 1D-03A Field Procedure for Field Reclosers

2.0 POLICY

One reclose attempt, manual or automatic, shall be done within 60 seconds after a forced outage unless:

- live Line Permits, Man Hole Permits, Assurance of No Reclose Permits, or Guarantee of No Reclose are in effect,
- the circuit is a “No Reclosing” circuit as defined in the Appendix, or,
- reclosing is blocked because of some unusual conditions, such as extreme fire conditions (see Section 4.4).

Any additional attempts to energize a circuit will only be done in compliance with Sections 4.2 and Section 4.3.

Multiple-shot reclosing sequence in automatic reclose is acceptable.

Anytime **a non reclose circuit is configured to carry the load of a reclose permitted circuit**, one reclose attempt will be permitted.

Anytime that two **series connected and electrically adjacent devices trip simultaneously**, one manual close of the upstream device will be attempted. Miscoordination or upstream conductor slap may be assumed.

When **a reclose permitted circuit is being carried on the station transfer bus**, one reclose of the transfer bus breaker is permitted in order to energize the feeder. A fault on the feeder may be assumed.

Anytime that **two circuits trip simultaneously, energization is not permitted** until a patrol has been completed**.** In these cases it is likely that bus protection will misoperate and trip at the same time as feeder trips. The bus may be restored but not the faulted feeders.

3.0 DEFINITIONS

Reclosing – Energizing a circuit within 60 seconds following a forced outage. Breaker closing can be manual, supervisory, or automatic. Only the circuits indicated in the Appendix as "Reclosing Permitted" may be reclosed.

Re-energizing – Energizing a circuit after precautions defined in Sections 4.2 and/or 4.3 have been completed. Re-energization will be manual or supervisory, but not automatic. All circuit energization performed later than 60 seconds from the time of the original forced outage are termed as re-energization.

4.0 PROCEDURES

The following instructions apply to automatic, manual or supervisory reclosing and re-energizing of distribution circuits following a forced outage when Live Line Permits, Man Hole Permits, Assurance of No Reclose Permits or Guarantee of No Reclose are **not in effect**:

4.1 Reclosing (Within 60 Seconds)

One reclose must be done within 60 seconds unless:

- the circuit is a "no reclosing" circuit as defined in the Appendix, or,
- the reclosing is blocked because of unusual conditions.

If a reclose attempt is not successful (breaker closes then trips), a subsequent reclose is not allowed.

Storm Conditions

If the System Control Manager (SCM) has declared that an area of BC is experiencing storm conditions (high winds, lightning, heavy rain or snowfall), Operators will be authorized to make two reclose attempts following a forced outage. This is providing that **the second attempt is within the original 60 second window**.

Extreme Fire Hazard

During periods when the BC Forest Protection Branch deems the fire hazard extreme, **all reclosing may be prohibited** on circuits as designated by the SCM. The factors to be considered are local fire hazard rating, location of circuit, impact on customers, etc.

4.2 Re-energizing (After 30/60 Minutes)

If an **outage cause has not been reported** to the BC Hydro Restoration Centre or the BC Hydro control centre within half an hour in urban areas and one hour in rural areas, **the Load Operator must consult with the SCM**. An additional energization may be authorized by the SCM after due consideration of the following:

- Location and recommendation of the field workers doing patrol.
- Existence of storm conditions.
- The estimated time required to patrol the line. Energization will be considered if the patrol time will be excessive and/or possibly hazardous to fieldworkers.
- Automatic reclosing had been blocked or failed to operate after the forced outage.

4.3 Re-energizing (No Time Constraint)

One re-energize should be attempted when one or more of the following conditions have been satisfied:

- The cause of the outage has been determined and corrected.
- The circuit has been sectionalized to isolate the faulted area. The faulted area can be determined by the Power Line Technician (PLT) or from trouble reports received by the BC Hydro Restoration Centre. **Priority is to minimize the**

overall number of customer hours lost during an event by using "switch before fix" methodology to isolate the faulted section and restore customers.

- The circuit has been visually inspected. Circuit patrols need not include protected laterals or areas not readily accessible to the public**.**

4.4 LLP/MHP/ANRP/GNR

When Live Line Permits, Man Hole Permits, Assurance of No Reclose Permits or Guarantee of No Reclose Permits are in effect, reclosing and re-energizing will not be attempted until the permit holder has been contacted **unless** the circuit has been de-energized by other than its own protection or the cause is known. When this condition is satisfied, reclosing / re-energizing will proceed as outlined in Sections 4.1 to 4.3.

4.5 Miscoordination With Field Reclosers

The likelihood of a fault occurring which would result in simultaneous tripping of two series and electrically adjacent devices is extremely low. In cases where two devices trip simultaneously, miscoordination or upstream conductor slap is assumed.

The Operator will attempt to immediately re-energize the circuit from the upstream device up to the open downstream device. Prior to closing the upstream device and where facilities exist, the Operator should verify the presence of fault current at the downstream device.

Note: In some cases where both the upstream and downstream devices have experienced simultaneous reclose cycles, the end state may be where the upstream device is open (de-energizing the entire circuit) and the downstream device is closed. When this is the case, the Operator should open the downstream device to isolate the fault and, providing that there are no LLP or ANR in effect, immediately close the upstream device.

In cases where the upstream device has no SCADA control, field personnel will need to be dispatched to close that device. Immediately upon the field workers arrival at the site, the BC Hydro control centre will direct a Close of the upstream device. Prior to issuing this instruction, the BC Hydro control centre should confirm with the BC Hydro Restoration Centre that no wires down have been reported between the two devices.

4.6 SCADA Timeout On Operate

Substation Breaker

When a substation breaker is closed into a faulted circuit, the breaker may trip so quickly that the EMS at the BC Hydro control centre may not register the operation and the control action will "Time Out On Operate". Should this occur, the Operator will assume that the breaker has closed and tripped and **will not attempt an additional Close** unless it can be verified that no actual close had occurred.

Electronic Recloser

When an electronic recloser is closed into a fault, the close/open operation will be reliably captured and reported back to the BC Hydro control centre EMS. When operating an electronic recloser (station or field installation) a "Time Out on Operate" may be assumed to be a control failure and not a Close/Open operation. In this case an **additional Close attempt is permitted.**

4.7 Circuits with Transmission Overbuild

Whenever a distribution circuit with transmission overbuild trips with an unsuccessful reclose (or no reclose facility exists) and the transmission overbuild has also been affected (coincident outage), the Load Operator and Grid Operator will inform the dispatched crews of the feeder / transmission outage to make them aware of each other's patrols.

A list of transmission circuits with distribution underbuild is included in 1T-29A Appendix B.

The Grid Operator is made aware of the distribution underbuild on the line-end display (e.g. 60Lxxx – One Reclose Only 1T-29A).

This practice is considered to be a "best effort" practice.

5.0 LINE PATROL

Applicability

- Patrol of all Level 4 Distribution circuits,
- Patrol of Level 5 circuits where the portion of the circuit being patrolled may be subject to energization by the closing of devices under direction of the PIC.
- This procedure is recommended but not mandatory for workers patrolling portions of Level 5 circuits where a Level 5 device under worker control has been opened to ensure that the circuit will remain de-energized.

Procedure

The PLT dispatched to patrol a circuit **must contact** the appropriate BC Hydro control centre Load Desk **prior to initiating patrol.** Upon contacting the Load Operator, the PLT and the Load Operator will exchange the following information where relevant:

- Names of the PLTs dispatched to patrol the circuit.
- Phone numbers or radio means best suited to contact the PLTs.
- Known hazardous conditions or reported fault locations, including a summary of re-energization attempts performed prior to initiating patrol.
- Abnormal circuit configurations.
- Partial circuit re-energization performed prior to the initiation of patrol.
- Fault data which may have been captured by SCADA controlled devices.
- Switch or fix restoration strategies to minimize customer interruption and minimize hazards.
- **Requirements the PLT may have for Live Line Permit while conducting patrol. (reference DOO 1D-15 and SOO 1T-18).**
- The time of circuit de-energization and the time when the SCM will consider authorizing an additional re-energization attempt (as per Section 4.2).

Note: Should a LLP be requested by the PLT, the BC Hydro control centre will take the necessary actions to establish the LLP. As per SPR 423.5, once a LLP is established, the BC Hydro control centre PIC will contact the LLP holder prior to any further attempts to re-energize the circuit.

6.0 REVISION HISTORY

Revised By	Revision Date	Summary of Revision
DP	22 February 2016	Appendix 1 – added circuits 414 and 425 to CSQ.
BH	19 June 2017	Section 4.7 – new; added for distribution underbuild policy per 1T-29A.
MDW	19 July 2017	Appendix 1 – removed CDL 12F54 and 12F55 (station de-commissioned).
DP	13 September 2017	Appendix 1 – added CSQ 415
DP	11 December 2017	Appendix 1 – updated COK, MAN, NEL, added KI2
MDW	11 July 2018	Appendix 1 – added HPN 320.
BH	13 August 2018	Appendix 1 – added MVL 25F53, MLE 25F53, BKB, FLW, MEX, SCX, SEL, SPN, SWN, TAT and updated BAB, BR1 12F51, GTP, FJN, GTP, HSY, KAL, KI1, KSH, LAJ, LTZ, MR2, NVR, PPS, QNL, SEA, SRS, VDF, WLM, removed WDS.
JM	06 December 2018	Appendix 1 – added NKL 25F75, 84 and 85; removed 73, 82 and 83.
B.L. Evans	12 April 2019	Appendix 1 – changed DGR 12F94
Ehson Syed	08 October 2019	Appendix 1 – added MPT 12F114, 121, 122, and 221.

APPENDIX 1
Circuits Permitted and Not Permitted to be Reclosed

STATION **CIRCUITS**

AFT	51	52
Reclose Status:	Y	Y

ALZ	51	52	53	54	62	63	64	65	71	72	73
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y

ANN	51	52	53	54	55	56	61	62	63	64	65	66
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y

ARM	51	52	53	54
Reclose Status:	Y	Y	Y	Y

ARN	31	32	33	34	40	41	42	43	44
Reclose Status:	Y	Y	Y	Y	N	Y	Y	Y	Y

ATH	51	52	53	61
Reclose Status:	Y	Y	Y	Y

AVO	52
Reclose Status:	Y

AYH	51	53
Reclose Status:	Y	Y

BAB	52
Reclose Status:	Y

BAL	50	52	54	55	56
Reclose Status:	Y	Y	Y	Y	N

BAR	51	52
Reclose Status:	Y	Y

BBR	51	52	53
Reclose Status:	Y	Y	Y

BKB	31	32	33	34	35
Recloser Status:	Y	Y	Y	Y	N

BKL	31	32	33	34	35	36	37	38
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y

BLU	52	53
Reclose Status:	Y	Y

BND	51	52	53	54	55	56	57	58	59	60	61	62	64	65
Reclose Status:	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N

	71	72	73	74	75	76	77	81	82	83	84	85	86	87
	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

	311	312	313	314	315	316	321	322	323
	N	Y	Y	N	Y	Y	N	N	Y

BR1	51
Reclose Status:	N

BRN	51	52	53	54
Reclose Status:	N	Y	Y	Y

BVY	51	52	53
Reclose Status:	Y	Y	Y

CAM	41	42	43	44	46	47	48	49	51	52	53	54	56	57
Reclose Status:	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

58	59	60	61
N	N	N	Y

CAP	50	51	52	53	54	55	56	57	58	59
Reclose Status:	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

CBL	50	51	52	53	54	55	60	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

CBN	110	111	112	113	114	120	121	124	125	211	212	213	214	215
Reclose Status:	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y

220	221	222	223	224
Y	Y	N	Y	Y

CHF	61	62	64	65
Reclose Status:	Y	Y	Y	Y

CHK	51	52	53	54	61	62	63
Reclose Status:	Y	Y	Y	Y	N	Y	Y

CHS	51	52
Reclose Status:	Y	Y

CKY	51	61
Reclose Status:	Y	Y

CLB	51	52
Reclose Status:	Y	Y

CLD	51	52	53	54	55	71	72	73	74	75	76	77	78	81
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y

82
Y

CLN	52	53
Reclose Status:	Y	Y

CLW	51	52
Reclose Status:	Y	Y

CMS	51
Reclose Status:	Y

CMX	31	32	33	34	35	36	37	38	51	52
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

CNL	51
Reclose Status:	Y

COK	611	612	613	615	621	622	623	710	711	712	713	714
Reclose Status:	N	N	N	N	Y	N	N	N	Y	Y	Y	Y
	723	724	811	812	813	814	821	822	823	824	614	625
	N	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y

COM	51
Reclose Status:	Y

CQM	*51*	*53*	*54*	*63*	*65*
Reclose Status:	*Y*	*Y*	*Y*	*Y*	*N*

CSN	71	72	73	74	75	76	77	78	81	82	83	84	85	86
Reclose Status:	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	N
	88													
	N													

CSQ

Reclose Status:												
	111	112	113	114	115	116	121	122	123	124	125	126
Reclose Status:	N	N	N	N	N	N	N	N	N	N	N	N
	211	212	213	214	215	216	221	222	223	224	225	226
	N	N	N	N	N	N	N	N	N	N	N	N
	311	312	313	314	315	316	321	322	323	324	325	326
	N	N	N	N	N	N	N	N	N	N	N	N
	411	412	414	415	422	423	424	425	511	512	513	514
	N	N	N	N	N	N	N	N	N	N	N	N
	515	516	521	522	523	524	525	526	611	612	613	614
	N	N	N	N	N	N	N	N	N	N	N	N
	615	616	621	622	623	624	625	626				
	Y	Y	N	N	N	N	N	N				

CWD	51	52	61
Reclose Status:	Y	Y	Y

DAW	51	52	53	54	55	56	63	65	66
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y

DCV	51	52	53	54	55	61	62	63	64
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	N

DIL	51
Reclose Status:	N

DGR	51	52	53	54	55	56	57	59	60	63	65	66	67	68
Reclose Status:	N	N	N	N	N	N	N	N	Y	Y	Y	N	Y	Y

69	70	71	72	73	75	76	77	78	79	80	81	82	83
Y	Y	N	N	N	N	N	N	N	N	N	N	N	N

84	86	87	88	89	90	92	93	94	95	96
N	Y	Y	N	N	N	N	N	N	Y	Y

DUG	24	51	52	53	54	55	57	60	61	62	63	64	65	66
Reclose Status:	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

67	68	58
Y	Y	Y

EFD	51	52
Reclose Status:	Y	Y

END	51	52
Reclose Status:	Y	Y

ESQ	51	52	53	54	55	56	57	58	71	411	412	413	414	415
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

421	422	423	424	425	426
Y	Y	Y	N	Y	Y

FCN	51	52	53	54	61	62
Reclose Status:	Y	Y	Y	N	Y	N

FHS	51	52	53	61	62
Reclose Status:	Y	Y	Y	Y	Y

FJN	53	55	56	61	63	64	65	66	67
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y

FLW	212	214	215	223	224	225	226
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

FM2	52	53
Reclose Status:	Y	Y

FMT	51	52
Reclose Status:	Y	Y

FNE	51	52	53
Reclose Status:	Y	Y	Y

FOX	51	52	61	62
Reclose Status:	Y	Y	Y	Y

FRC	51
Reclose Status:	Y

FSR	51	52
Reclose Status:	Y	Y

FST	51	53
Reclose Status:	Y	Y

FVW	52	53	54	55
Reclose Status:	Y	Y	Y	Y

GDK	53	54	55	56	58	59	60	61	62	63	64	65
Reclose Status:	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

GDN	51	52	53	54
Reclose Status:	Y	Y	Y	Y

GIB	52	53	54	64
Reclose Status:	Y	Y	Y	N

GLD	61	62
Reclose Status:	Y	Y

GLR	51	52	53	54	61	62	63	64
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y

GLS	51	52
Reclose Status:	Y	Y

GLT	52	53
Reclose Status:	Y	Y

GOW	111	112	113	114	121	122	123	124	125
Reclose Status:	Y	Y	Y	N	Y	Y	Y	Y	Y

GPT	51	52	53	54	55
Reclose Status:	Y	Y	Y	Y	Y

GRR	51
Reclose Status:	N

GTP	41	42	43	44	46	47	48	49	51	52	53	54	56	57
Reclose Status:	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

58	59	61	62	63	64
N	Y	N	Y	N	Y

GVL	51	52
Reclose Status:	Y	Y

HCT	411	412	413	421	422
Reclose Status:	N	Y	Y	Y	Y

HFY	51	53
Reclose Status:	Y	Y

HLD	51
Reclose Status:	Y

HMH	51	52	53	63	64
Reclose Status:	Y	Y	Y	Y	Y

HNY	51	52	53	54	55	56	57
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

HOP	51	53	55
Reclose Status:	Y	Y	Y

HPN	51	52	53	54	55	56	57	58	59	60	61	62	72P	72Q
Reclose Status:	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y

73P	73Q	74P	74Q	75P	75Q	76P	76Q	77P	77Q	311	312	313	314
Y	Y	Y	Y	N	Y	N	N	N	Y	N	Y	Y	Y

315	316	317	318	320	321	322	323	324	325	326	327
Y	N	Y	N	N	N	N	Y	Y	N	Y	Y

HRD	51	52	53	54	55	61	62	63	64	65
Reclose Status:	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

HSB	51	52	53	54	55
Reclose Status:	Y	Y	Y	Y	Y

HSY	52	53	54	55	56	57	58	62	63	67	68	71	72	81
Reclose Status:	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
	82	83	84	111	112	113	114	121	122	123	124	125	212	321
	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	322	331	332	341	342	351	352	361	362	371	372	421	422	431
	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	Y	Y
	432	462	471	472										
	Y	Y	Y	N										

HUS	61	62	63
Reclose Status:	Y	Y	N

HWD	31	32	33	34	35	36	37	38	51	52
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

HZN	51	52	53	54
Reclose Status:	Y	Y	Y	Y

ILL	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y

INV	31
Reclose Status:	Y

IPR	51
Reclose Status:	Y

JLN	51P	51Q	52P	52Q	53P	53Q	54P	54Q	61P	62P	62Q
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N

JOE	52	53	54	55
Reclose Status:	Y	Y	Y	Y

JOR	52	53
Reclose Status:	Y	Y

JUL:	51
Reclose Status	Y

KAL	51	52	53	54
Reclose Status:	Y	Y	Y	Y

KDS	51	52
Reclose Status:	Y	Y

KEN	51	52	53	54
Reclose Status:	Y	Y	N	Y

KGH	52	53	54
Reclose Status:	Y	Y	Y

KI1	51	52	53	54	55	56	58	59	60	61	62	111	112	113
Reclose Status:	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
	114	115	121	122	123									
	Y	Y	Y	Y	N									

KI2	112	113	123	124	125	126
Reclose Status:	Y	N	Y	Y	Y	N

KSH	72	74	75	81	82	83	84	85
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y

KTG	111	112	113	114	115	121	122	123	124
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y

LAJ	51
Reclose Status:	Y

LBH	51	52	53
Reclose Status:	Y	Y	Y

LBY	51	52
Reclose Status:	Y	Y

LCW	61	62	63
Reclose Status:	Y	Y	Y

LDY	51	52	53	55	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

LOH	51	52	53	54	55	56	61	62	64	67	68
Reclose Status:	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y

LTZ	111	112	113	114	121	122	123
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

LU2	51	52	53	54
Reclose Status:	Y	Y	Y	Y

LYN	111	112	113	114	115	116	120	121	122	123	124	125	126
Reclose Status:	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	Y	Y
	211												
	Y												

LYT	51
Reclose Status:	Y

MAN	51	52	53	54	55	56	57	59	61	63	64	65	66	67
Reclose Status:	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
	68	69	71	72	73	74	75	76	77	78	79	80	81	82
	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	Y
	83	84	85	86	87	88	89	90						
	N	Y	Y	N	Y	Y	Y	Y						

MCK	51
Reclose Status:	Y

MEZ	52
Reclose Status:	Y

MFE	51	53
Reclose Status:	Y	Y

MGT	51	52
Reclose Status:	Y	Y

MIN	55	56	57	58
Reclose Status:	Y	Y	Y	Y

MIS	51	52	53	61	62	63	64
Reclose Status:	Y	N	Y	Y	Y	Y	Y

MLE	51	52	53	54	61	62	63	64	65
Reclose Status:	Y	Y	N	Y	Y	N	Y	Y	Y

MLN	30	31	32	33	34	41	42	43	44	61	62	63	64
Reclose Status:	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

70	72	73	74	75
N	Y	Y	Y	Y

MPT	111	112	113	114	115	121	122	125	212	213	221	311	312	313
Reclose Status:	N	N	Y	N	Y	N	Y	N	N	N	N	N	Y	Y

314	315	321	322	323	324
Y	N	N	Y	Y	Y

MON	51
Reclose Status:	Y

MRG	52	53	54	55	56	60	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

MR2	111	112	113	114	115
Reclose Status:	Y	Y	Y	Y	Y

MTE	52
Reclose Status:	Y

MUR	51	51P	51Q	52Q	53Q	55	55Q	57Q	58P	59Q	60	60P	61	61P
Reclose Status:	Y	Y	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y

61Q	62P	65	66	71	73	74	75	78	79	80	81	82	83
Y	N	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y

84	85	86	87	90	91	92	93	94	98	99	100
Y	N	N	N	N	Y	N	N	N	Y	Y	Y

MVL	51	52	53
Reclose Status:	Y	Y	N

MWN	52	53
Reclose Status:	Y	Y

MYE	51	52
Reclose Status:	Y	Y

NAK	51	52	53	54
Reclose Status:	Y	Y	Y	Y

NDR	51	52
Reclose Status:	Y	Y

NEL	51	52	53	54	55	56	57	58	59	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	Y
	66	67	68	69	71	72	73	74	75	76	77	78	81	82
	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y	Y
	83	84	85	86	87	88	91	93	311	312	313	314	315	321
	Y	Y	Y	Y	N	Y	N	Y	N	N	N	N	Y	N
	322	323	324	325	326									
	Y	N	N	N	Y									

NFD	50	51	52	53	54	55	60	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

NKL	71	72	74	75	81	84	85
Reclose Status:	Y	N	Y	Y	Y	Y	Y

NOR	51	52	53	54	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	N	Y	Y

NVR	111	112	113	114	115	116	117	121	122	123	124	125	126	127
Reclose Status:	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y

NWR	51	52	53	54	55	56	62	63	64	75	76	82	83	84
Reclose Status:	N	N	N	N	N	N	N	N	N	N	N	N	N	N

OFD	51	52	53	55	56	57	66	67	68
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y

OYR	51	61
Reclose Status:	Y	Y

PAL	71	72	73	74	75	76	77
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

PAV	51
Reclose Status:	Y

PCA	51	52	53	54	55	56	57	58	59	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

	66	67	68	69	70
	Y	Y	Y	Y	Y

PED	51	52
Reclose Status:	Y	Y

PEM	51	52	61
Reclose Status:	Y	Y	Y

PGG	51	52	53	57
Reclose Status:	N	N	N	N

PHR	53	62
Reclose Status:	Y	Y

PHY	51	52	53
Reclose Status:	Y	Y	Y

PKL	50	52	53	54	55	61	62	63	64	65
Reclose Status:	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

PML	51	52	53
Reclose Status:	Y	Y	Y

PPS	52	54	56
Reclose Status:	Y	Y	N

PSN	53
Reclose Status:	Y

PTO	51
Reclose Status:	Y

PUN	54	55	61	62	63	64	65	66
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y

PVL	51	52	53	54	55	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

PVO	51	52	53	54	55	56	57
Reclose Status:	Y	Y	Y	Y	Y	Y	Y

PVW	51	52	53	64	65
Reclose Status:	Y	Y	Y	Y	Y

QLC	51	52	53	61	62
Reclose Status:	Y	Y	Y	Y	Y

QNL	48	49	50	53	54	58	60
Reclose Status:	Y	N	Y	Y	N	N	Y

RBF	41	43	44	47	48
Reclose Status:	Y	Y	Y	Y	Y

RBW	21	22	51	52	53	54	61	62	63	64	65	66	67
Reclose Status:	N	Y	N	Y	N	N	Y	Y	Y	N	Y	N	N

RDM	51	52	53
Reclose Status:	Y	Y	Y

RIM	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Reclose Status:	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N
	65	66	67	68	69	70								
	N	Y	Y	Y	Y	N								

RO2	51	52	53	54	55	61	62	63	64
Reclose Status:	N	N	N	N	N	N	N	N	N

SAC	51
Reclose Status:	Y

SAL	54	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	Y

SAM	71	72	73	74	75
Reclose Status:	Y	Y	Y	Y	Y

SBR	51
Reclose Status:	Y

SCM	51	52	53	54
Reclose Status:	Y	Y	Y	Y

SCT	50	51	53	54	55	56	57	58	59	60
Reclose Status:	Y	N	Y	Y	Y	Y	Y	Y	N	Y

SCX	51	52	53
Reclose Status:	Y	Y	Y

SEA	51	52	53	54	55	56	62
Reclose Status:	N	Y	Y	N	Y	N	N

SEC	51	61	62	63	64
Reclose Status:	Y	Y	Y	Y	Y

SEL	51
Reclose Status:	Y

SHA	51	52	54	61	62	63
Reclose Status:	Y	N	Y	Y	Y	Y

SKU	52
Reclose Status:	Y

SMH

	51	52
Reclose Status:	Y	Y

SMW

	51	52	53	61	62	63
Reclose Status:	Y	Y	N	Y	Y	Y

SNY

	53	54	55	62	63	64	65	66
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y

SON

	63	64	65
Reclose Status:	Y	Y	Y

SOO

	51	71	72	73	74
Reclose Status:	Y	Y	Y	Y	Y

SPG

	61	62	63	64	65	66	67	68	75	76	77	78	79	80
Reclose Status:	N	N	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Y
	85	86	87	88	89	90	111	112	113	114	115	116	121	122
	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
	123	124	125	126	411	412	413	414	421	422	423	424		
	Y	Y	N	Y	Y	N	N	N	Y	N	Y	Y		

SPL

	51	52	53	54
Reclose Status:	Y	Y	Y	Y

SPN

	52
Reclose Status:	Y

SQH

	51	52	53	55
Reclose Status:	Y	Y	Y	Y

SRS	51	52	53	54	63	64
Reclose Status:	Y	Y	Y	Y	Y	Y

SRY	50	51	52	53	54	55
Reclose Status:	Y	Y	Y	Y	N	Y

STO	62	63	64	65
Reclose Status:	Y	Y	Y	Y

STV	511	512	513	521	522	611	612	613	620	621	622	623
Reclose Status:	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

STW	51	52
Reclose Status:	Y	Y

SVA	51
Reclose Status:	Y

SWN	31	32	33	34	35
Reclose Status:	Y	Y	Y	Y	Y

SYH	40	41	43	44	46	47	48	49	51	52	53	54	55
Reclose Status:	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

	56	57	58	311	312	313	314
	Y	Y	Y	Y	Y	Y	N

SZM	51
Reclose Status:	Y

TAT	51
Reclose Status:	Y

TER

TER	51	52	53
Reclose Status:	Y	Y	Y

TLR	51	52	53
Reclose Status:	Y	Y	Y

TSV	52
Reclose Status:	Y

TSW	51	52	53	61	62	63
Reclose Status:	Y	Y	N	Y	Y	Y

TXL	51
Reclose Status:	Y

UFR	51	52
Reclose Status:	Y	Y

UHT	51
Reclose Status:	Y

VBY	51	52
Reclose Status:	Y	Y

VDF	51	52	53	54
Reclose Status:	Y	Y	Y	Y

VLM	51	52	53
Reclose Status:	Y	Y	Y

VNT	51	52	53	54	55	56	61	62	63	64	65	66	71
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

WAH	51	52	53	54
Reclose Status:	Y	Y	Y	N

WAR	51
Reclose Status:	Y

WBK	51	52	53	54	55	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y	N	Y	Y	Y	Y

WHY	111	112	113	114	115	121	122	123	124	125	211	212	213	214
Reclose Status:	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y

	215	221	222	223	224	225
	N	Y	Y	N	Y	Y

WLM	55	56	57	64	65	66	67	68
Reclose Status:	Y	Y	Y	Y	Y	Y	Y	N

WOS	51
Reclose Status:	Y

WRK	54	55	56	57	60	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	N	Y	Y	Y	Y	N

WSP	61	62	63	64	65
Reclose Status:	Y	Y	Y	Y	Y

WWD	51	52
Reclose Status:	Y	Y