# BC HYDRO

## T&D SYSTEM OPERATIONS

## SYSTEM OPERATING ORDER 7T–30

## NORTH COAST INTERCONNECTION

Supersedes SOO 7T-30 issued 22 November 2022

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*Original signed by:*

**APPROVED BY:** ________________

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# Index

## 1.0 GENERAL

This System Operating Order (SOO) describes the operation of the North Coast (NC) Transmission System, including the Williston (WSN) – Skeena (SKA) – Rio Tinto Aluminum (RTA) interconnection facilities, and the Skeena (SKA) – Bob Quinn (BQN) subsystem.

This SOO provides Operating Procedures for the greater North Coast Interconnection operations.

Further, this SOO documents System Operating Limits (SOL), Remedial Action Scheme (RAS) Arming Requirements, Reliability Must Run (RMR) requirements for the greater North Coast Interconnection in Sections 9, 10, 11, 12, and attachments.

For system operating conditions (including configurations and KIT load scenarios not specified in this SOO), consult T&D System Operations - Operations Planning for operational instructions, including 2L103 transfer limits, and generation shedding requirements.

Variations from these Operating Procedures, Operating Limits, RAS Arming conditions, RMR and RAS arming conditions, for specific temporary operating conditions, will be provided through additional Operating Plans on a case by case basis. These Operating Plans are engineered to support outages and short term operating requirements, superseding as necessary requirements in this order.

References:

The following Operating Orders should be referenced or reviewed with this order:

- SOO 1T-11A: Operating Responsibility and Operating Authority Assignment to Desks
- SOO 5T-10: Rating For All Transmission Circuits 60 kV or Higher
- SOO 5T-13: Switching Procedures for 2L102, 2L374, and 2L379
- SOO 5T-78: HUS, SRS, HZN Load Transfer to 1L398
- SOO 6T-28G: Automatic Underfrequency Load Shedding – Northern Region – NorthEast/West Area
- SOO 6T-73: Prince Rupert Area Restoration and Islanded Operations
- SOO 7T-18: BC – US Interconnection
- SOO 7T-64: Rotational Energy to Support Transfer Limits
- LOO 3T-BQN-01: Bob Quinn Substation Operation

Applicable Site/Station Definitions and Terminology:

TVC - Transmission Voltage Customer
IPP - Independent Power Producer
TSA-PM – BC Hydro's EMS Advanced Application for Transient Stability Analysis.

The following sites/stations are referred to throughout this SOO. Owner/Operator relationships are noted as exceptions; otherwise assumed as BC Hydro owned and operated.

BQN refers to Bob Quinn Substation
FKR refers to the Forrest Kerr Generating Station (owned and operated by AltaGas)
FKR IPP refers to the IPP facilities owned and operated by AltaGas
KIT refers to Kitimat Substation and Smelter (owned and operated by Rio Tinto Aluminum)
KMO refers to Kemano Generating Station (owned and operated by Rio Tinto Aluminum)
GLN refers to Glenannan Substation
MCY refers to McLymont Creek Generating Station (owned and operated by AltaGas)
MIN refers to Minette Substation
RDC refers to Red Chris Mine TVC (owned by Red Chris Development)
RPG refers to Rupert Gas Generating Station
RTA refers to the Rio Tinto Aluminum company and its generation, transmission and load facilities

RUP refers to Rupert Substation
SKA refers to Skeena Substation
TAT refers to Tatogga Substation
TKW refers to Telkwa Substation
VOL refers to Volcano Creek Generating Station (operated by AltaGas)
WSN refers to Williston Substation

## 2.0 RESPONSIBILITIES

BC Hydro (BCH) operation and maintenance responsibilities are defined in SOO 1T-11A and related Operating Orders.

The RTA System Operator is responsible for:

- Notifying the BCH Control Centre (BCHCC) Operator as soon as practical, by dispatch intercom, of:
    - Any KIT potline start-up or shutdown.
    - Any KMO generator start-up or shutdown.
    - Any KIT shunt capacitor energization or de-energization.

- For planned operations, notification is to be made prior to any actual switching operation.
    - E-mailing or faxing confirmation of the above operations to the BCHCC Operator.
    - Maintaining the interconnection power flow as agreed with BCHCC Operator.
    - Preventing KIT to MIN flow from exceeding the limits in Section 10 of this Order, by reducing tieline flow immediately prior to:
        - A Potline shutdown, or
        - Line switching which offloads – KMO-KIT lines.
    - Preventing MIN to KIT from exceeding the limits in Section 9 of this Order, or as established in a BC Hydro Operating Plan.
- Establishing frequency setpoint changes when instructed by the BCH Control Centre (BCHCC) Operator, for islanded operation of the North Coast Transmission system (see Section 14).

AltaGas Ltd. responsibilities to contact the BC Hydro Control Centre are outlined in Local Operating Order (LOO) 4T-FKR-01 Sections 2 and 10.

Red Chris Mines is responsible for informing BC Hydro of substation equipment status.

The BCHCC Operator is responsible for:

- Updating the status of the RTA equipment in the Energy Management System (EMS) when notified of changes by the RTA System Operator.
- Communicating with the RTA System Operator prior to energizing or de-energizing 5L61, 5L62, 5L63, 2L99 or 2L103 (so joint action can be taken to minimize the impact on RTA operations caused by voltage fluctuations). Communicating and implementing switching instructions.
- Issuing and tracking Safety Protection Guarantees (SPG) and Guarantees of Isolation (GOI).
- Notifying customers of expected system conditions and possible special operating requirements prior to any scheduled separation.
- Updating the status of the BQN and FKR equipment in the Energy Management System (EMS) when notified of changes by the FKR IPP System Operator.
- Communicating with the FKR IPP Operators prior to energizing or de-energizing 2L379 or 2L102, so joint action can be taken to minimize the system impacts.
- Leading and directing load pick up, generation changes, voltage control and synchronizing actions for operating with 5L61, 5L2 or 5L63 permanent faults.

## 3.0 NORTH COAST FACILITIES

This section describes the non-BC Hydro facilities and configurations, in the North Coast interconnection. These facilities include RTA's generation, transmission and loads (SKA-RTA Interconnection), and SKA-BQN subsystem that includes IPP generation and TVC loads.

### 3.1 RTA's Kemano Generating Station (KMO)

KMO consists of eight (8) generators, with a plant capability of 1010 MW. Detailed unit information is provided in the table below:

| KMO UNIT | Pmax (MW) | MVA | Qmax (Reactive power injecting capability) (Mvar) | Qmin (Reactive power absorbing capability) (Mvar) |
|---|---|---|---|---|
| 1 | 122 | 128 | 39 | -39 |
| 2 | 122 | 128 | 39 | -39 |
| 3 | 124 | 131 | 42 | -42 |
| 4 | 124 | 131 | 42 | -42 |
| 5 | 130 | 137 | 43 | -43 |
| 6 | 133 | 140 | 44 | -44 |
| 7 | 133 | 140 | 44 | -44 |
| 8 | 122 | 128 | 39 | -39 |
| Total | 1010 | | 332 | -332 |

- All four generator step-up transformers have a rating of 396 MVA. Each bank can handle the full output of three units.

Normal operation is:

- Two units connected to each one of four generator step up transformers.
- Two 287 kV main busses connected to two generator transformers and one Kemano-Kitimat transmission circuit.
- The 287 kV circuit breaker that ties the two 287 kV main busses is closed (CB121).

### 3.2 RTA's Kemano - Kitimat Transmission Lines

With two lines in-service and KMO at 850 MW, the transmission line losses are 12 MW.

With one line in-service and KMO at 730 MW the transmission line losses are 18 MW.

### 3.3 RTA's Kitimat Substation (KIT)

#### 3.3.1 Description of Kitimat Smelter

RTA has installed Aluminum Pechiney low emissions and energy efficient AP40 smelting technology and the capacity is increased to 420,000 tonnes per annum. KIT consists of a smelter with 384 pots in one potline (replacing the 7 original potlines). In addition, a new casthouse, anode bake plant and upgraded carbon and material facilities are provided as part of the facility modernization.

The smelter is supplied with power generated at KMO over two 80 km 315 kV transmission lines.

The main electric equipment related to the smelting facilities consists of five rectifier groups operating in parallel that will provide maximum 420 kA at 1650 Vdc for the reduction process. Each rectifier group comprises a regulating transformer, a rectifier transformer and a 12 pulse rectifier.

The process also employs a magnetic compensation loop which is fed by redundant rectifiers, each rated 90 kA / 40Vdc, and with its associated transformer.

Two 65 MVA auxiliary transformers supply plant electrical power to the facilities at 25 kV.

3.3.2 Potline Characteristics

The plant has only one potline with 384 pots connected electrically in series using AP40 smelting technology.

- Number of potlines: 1 unit
- Number of rectifiers for one potline: 5 unit
- Number of pots: 384 pots
- Rated current of one rectifier: 105 kA
- Mean Voltage per pot: 4.10 V
- Potline operating current: 405 kA
- Potline maximum voltage: 1650 V @ 405 kA
- Production per pot and day: ≈ 2995 kg / day
- Auxiliary power supply (MV): 25 kV
- Energy consumption: 405 kA 688 MW (incl. auxiliary load)

3.3.3 Estimated KIT Plant Load

Each of the rectifier filters will have an estimated reactive power of 62.5 MVAR (based on 28.2 kV), fixed independent of the rectifier load.

Four of the existing shunt capacitor banks installed at 13.8 kV are retained for the site. The existing 32.4 MVAR capacitor bank at 13.8 kV will produce 36.6 MVAR at the 287 kV bus.

Plant load information has been provided in the following table. (table follows on next page).

**Table: RTA Plant Load Information**

| | Normal | Design | Design with 2 Additional Capacitor Banks | Minimum Normal | Minimal Design | Minimum Design with One Additional Capacitor Bank | Emergency Normal | Emergency Design |
|---|---|---|---|---|---|---|---|---|
| Rectifiers in service | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 3 |
| Harmonic Filters in service | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 3 |
| Potline (PL) Current kA | 405 | 405 | 405 | 380 | 380 | 380 | 315 | 315 |
| Plant PF (Including the 32.4 MVAr each shunt capacitors) | 0.997 lag | 0.967 lag | 0.988 lag | 1.0 | 0.983 lag | 0.992 lag | 0.999 lead | 0.980 lag |
| Q (MVAr) - Total Plant Power (including the existing 32.4 MVAr each shunt capacitors) | 53.2 | 177.7 | 104.5 | -4.0 | 116.6 | 80.0 | -13.2 | 96.2 |
| Q (MVAr) - Total Plant Power (excluding the existing 32.4 MVAr each shunt capacitors) | 126.4 | 250.9 | 250.9 | 69.2 | 189.8 | 189.8 | 60.0 | 169.4 |
| P (MW) - Total Plant Power | 684 | 670.7 | 670.7 | 623.9 | 621.4 | 621.4 | 477.6 | 475.4 |
| Q (MVAr) - 13.2 kV Auxiliary | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Q (MVAR) - Shunt Capacitor installed 13.2 kV Auxiliary (Existing) | 73.2 (2 X 36.6) | 73.2 (2 X 36.6) | 146.4 (4 X 36.6) | 73.2 (2 X 36.6) | 73.2 (2 X 36.6) | 109.8 (3 X 36.6) | 73.2 (2 X 36.6) | 73.2 (2 X 36.6) |
| P (MW) - 13.2 kV Auxiliary | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Q (MVAr) - 25 kV Auxiliary | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| Q (MVAR) - Shunt Capacitor installed 25 kV Auxiliary | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| P (MW) - 25 kV Auxiliary | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| PF at output of each regulating $X_{fo}$ | 0.908 lag | 0.890 lag | 0.890 lag | 0.912 lag | 0.896 lag | 0.896 lag | 0.897 lag | 0.882 lag |
| Q (MVAr) at output of each regulating $X_{fo}$ | 59.3 | 80.4 | 80.4 | 52.4 | 71.9 | 71.9 | 53.8 | 77.4 |
| P (MW) at output of each regulating $X_{fo}$ | 128.5 | 157.1 | 157.1 | 116.5 | 145.0 | 145.0 | 109.0 | 144.5 |
| Tap Position | 103 | 107 | 107 | 98 | 103 | 103 | 90 | 95 |
| Potlines (MVAr) at input of Regulating transformer combined | 96.4 | 220.9 | 220.9 | 39.2 | 159.8 | 159.8 | 30.0 | 139.4 |
| Potlines (MW) at input of Regulating transformer combined | 644 | 630.7 | 630.7 | 583.9 | 581.4 | 581.4 | 437.6 | 435.4 |
| ($L_{sat}$) Saturable reactor Voltage drop ($V_{dc}$) | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| Potline PF at input of Regulating transformer combined | 0.989 | 0.944 | 0.944 | 0.998 | 0.964 | 0.964 | 0.998 | 0.958 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Potline Voltage (Vdc) | 1580 | 1545 | 1545 | 1527 | 1519 | 1519 | 1379 | 1370 |
| Network Voltage (kV) | 285 | 285 | 285 | 285 | 285 | 285 | 285 | 285 |

3.4 Skeena - Bob Quinn Subsystem

The Skeena – Bob Quinn Subsystem is an extension of transmission lines and facilities that includes the interconnection of IPP generation (Forrest Kerr, Volcano Creek, McLymont Creek), Red Chris Mine TVC, Tatogga Substation, and the interconnecting transmission lines and facilities.

The subsystem's facilities include:

- Reactors:
  - In the normal configuration, SKA 2RX1, BQN 2RX231 and BQN 2RX232 are in service;
  - BQN 2RX232 is normally on tap B, 35 MVAR rating;
  - BQN 2RX22 are in-service;
  - BQN 2RX25 is only allowed to be in-service when 2L374 is energized, otherwise it must be out of service; and
  - SKA 2RX2 is normally left out of service but available for use in replacing one of the other line reactors at SKA or BQN (on a forced or planned outage).

- Series Capacitor:
  - BQN 2CX1 is normally in-service, and located on the source side of BQN station (i.e. BQN 2L102 terminal). See LOO 3T-BQN-01 for information on automatic control functions.
  - When inserted, the voltage across the series capacitor will increase the voltage seen on the load side of the BQN Substation by approximately 2.3 kV. The purpose of the series capacitor is for improving the transmission system angular and voltage stability requirements and the ability to transfer more power across the same transmission circuit. It has been designed to provide 35% of the line series reactance of 2L102.

- Harmonic Filtering:
  - BQN 25HF4 is a 4th harmonic filter attached to the secondary of BQN T3. It is normally in-service. See LOO 3T-BQN-01 for further information on ratings and protection.
  - System studies identified a parallel resonance condition near the 4th harmonic as seen looking into the BC Hydro system from the Forrest Kerr Substation. The purpose of 4th harmonic filter 25HF4 at BQN is to mitigate high and very slow decaying temporary overvoltage on 1L381 and 1L387 (in the SKA area) which would result if the fourth harmonic parallel resonance condition is excited.

- 2L102 - a 340.2 km 287 kV transmission line connecting SKA at Terrace to BQN near Bob Quinn Lake.

- 2L379 - a 38.7 km 287 kV IPP owned transmission line connecting FKR IPP to the BQN 287 kV bus.

- FKR/VOL/MCY generating stations are located approximately 500 km north of Terrace. MCY is connected to the FKR switchyard via owned and operated 10 km, 69 kV line.

- The capacity of FKR, VOL and MCY is 300 MW assuming 0.9 PF. The capacity of the three run-of-the-river hydroelectric generation plants is:
  - FKR: (9) 26.1 MVA units.
  - VOL: (2) 10 MVA units.
  - MCY: (3) 26.67 MVA units.

- 2L374 - a 93 km transmission line connecting BQN to TAT, and extends another 22 km to RDC.

- RDC is a copper/gold mine TVC. In addition to the 287 kV substation and 2L374, the RDC site features:
  - An entrance circuit breaker with Point-on-wave switching for converter transformer energization to control voltage sag at the POI.
  - Fibre Optic Cable from BQN to RDC with communication channel for transfer tripping and Remedial Action Schemes (RAS).

## 4.0 VOLTAGE CONTROL

With the system normal and all reactive equipment in service a nominal 535 kV should be attainable on the GLN, TKW and SKA 500 kV busses, with WSN at 525 kV, and with KIT at 285 kV, and SKA transformers on the 512.5/287 kV off load taps. The BQN normal operating voltage range should be between 287-304 kV. The system nominal voltage is 287 kV. Voltages must be kept below 315 kV except for short times during switching when higher voltages cannot be avoided.

### 4.1 TKW and SKA Auto-Var Control (AVC) Scheme

When connected to the WSN 500 kV bus, both the TKW and SKA auto-var control (AVC) schemes should be turned "ON". The schemes will regulate pre- and post-contingency SKA and TKW voltages within 510 and 535 kV.

The TKW and SKA AVC should be "OFF" when TKW is operated in an islanded area. The TKW and SKA 12 kV reactors that should be in service will be determined prior to islanding the North Coast.

The TKW AVC will switch TKW 12RX2 and 12RX3 within a normal voltage range of 535.9 – 510.2 kV (see TKW PN sheets for details). TKW 12RX2 is normally first in and first out if both reactors are available. If 12RX2 is not available then 12RX3 operates to maintain the normal voltage range.

The SKA AVC will switch SKA 12RX1 and 12RX2 within a normal voltage range of 535 – 510 kV. SKA 12RX1 is normally first in and first out if both reactors are available. If 12RX1 is not available then 12RX2 operates to maintain the normal voltage range. Both reactors will switch for voltage settings outside of the normal range and between 465 kV and 565 kV (see SKA PN sheets for details).

RTA will regulate their KIT bus to 285 kV +/- 1% using KMO generation and KIT's (4) 32 MVAR, and (1) 55 MVAR shunt capacitors.

SKA's 37 MVAR shunt reactor(s) will be required off line only during high transfers with RTA combined with line outages (one of the KIT–KMO lines, or 5L61, or 5L62 or 5L63).

GLN, TKW and SKA low voltage bus voltages will be regulated using the low voltage transformer "on line" tap changers.

### 4.2 Bob Quinn Auto-Var Control Scheme (BQN AVC)

BQN 2RX22 is equipped with an Auto-VAR scheme; it is normally kept "ON". See LOO 3T-BQN-01 Section 4.0 for further details.

### 4.3 BQN Special Operating Considerations

BQN 2RX232 and BQN 2RX231 must be in service at all times to support voltage control in the area. The reactors can be removed with lines de-energizations (see SOO 5T-13). The reactors can be removed for their maintenance, with reconfiguration of the system reactors at SKA and BQN to support the reactive needs in the region (see Section 3.4).

In an emergency or a last resort in normal operations, BQN 25HF4 can be removed from service to aid voltage control (for high system voltages). The filter provides about 3.6 MVars relief.

### 4.4 Forrest Kerr Automatic Voltage Regulators (FKR AVRs)

The FKR AVRs (generator AVRs) will normally be operated in automatic voltage control mode and used to regulate each generator's terminal voltage. Operation in other control modes (e.g. constant power factor control) must be authorized by BC Hydro.

### 4.5 Self Excitation Risk for Rupert Generation

If tripping at SKA leaves 2L101 energized from RUP, self-excitation of the RPG generation may occur. An overvoltage relay at RUP set at 345 kV will trip 2L101 via a 0.7-second timer.

RPG generators are permitted to be on line prior to Switching 2L101, allowing for make before break operations, to ensure continuity of load service during planned switching of the line. The exposure duration of the generators to parallel operation should be minimized.

### 4.6 Operation Without 500 kV Shunt Reactors

WSN voltage may have to be maintained below 510 kV to avoid exceeding 542 kV at GLN and 550 kV at TKW when a line reactor is out of service at these substations.

Operation of a 500 kV line without its associated reactor may result in false tripping of the line on a reverse fault. This is permissible for short periods but Protection personnel should be called out to make relay-setting changes on the affected line. Protection settings will be returned to normal when the line and its associated shunt reactor are returned to service.

Leave single pole reclosing in service but auto-reclose may be unsuccessful and result in a three-pole trip. Reclose time can be increased to 1.5 sec to allow SLG fault clearing while shunt reactor is out-of-service. Studies have indicated that increased single pole open time will not cause instability and should not limit normal RTA or Peace River transfers. Any power transfers beyond normal limits should be studied before allowed. Reclose time must be returned to normal settings when line with its shunt reactor is returned to service.

## 5.0 PROTECTION AND AUTORECLOSING

### 5.1 Single Pole (Single Phase) Reclosing

5L61, 5L62, 5L63, 2L102 and 2L379 are capable for single pole reclosing operation.

The positions for the Reclose Selector Switch - 79CS are:
Position 1 - No reclosing
Position 2 - Not used
Position 3 - Three phase reclosing only
Position 4 - Single phase reclosing only
Position 5 - Single and three phase reclosing

An unsuccessful single pole reclose attempt will evolve into three phase tripping of line end CBs.

5L61, 5L62 and 5L63 will be operated with reclosing in Position 4 (Single phase reclosing only). The reclose selector switch should normally be in the same position at both ends of the lines.

2L379 will be operated with reclosing in Position 1 (No Reclosing - 3 pole trip for all faults). BQN is designated the lead end.

2L102 will be operated with reclosing in Position 4 (Single phase reclosing only - Trip/Reclose for SLG trips only) at SKA and BQN ends.

- SKA is designated the lead end.
- Forced three pole tripping: If generation from FKR (incoming power flow on 2L379) is below a setpoint (45 MW), the BQN RAS Logic IED will signal 2L102 protection to only trip 3 pole. To ensure consistent tripping even if one RAS Logic IED is out of service, each RAS Logic IED is connected to both PY and SY 2L102 line PNs.

## 5.2 2L102 Reclosing Special Requirements

For 2L102:

- Three phase tripping,
- Unsuccessful single-pole-reclose,
- Detection of 2L102 open terminal, and
- Receipt of trip signals from 2RX231 and 2CX1 protections,

the 2L102 protections will trip into BQN 2L379 protections, which in turn trip BQN 2CB1 and BQN 2CB2, and key a DTT to FKR generation. This requirement is necessary to avoid temporary overvoltages for BC Hydro customers, when BQN becomes isolated from SKA.

When additional load/generation is connected to the BQN station, these devices 87L/87LS will extend this tripping to include those loads and generation.

BQN will receive a non-reclosable DTT from SKA for events including:

- terminal breaker failure,
- detection of system overvoltage
- line connected shunt reactor protection operation.

SKA will send BQN a sustained DTT to allow the shunt reactors time for auto isolation.
BQN Devices 87L/87LS will block close for BQN 2CB1 and BQN 2CB3 until the received DTT resets.

## 5.3 Overvoltage Tripping at BQN

If BQN bus voltage exceeds 1.1 pu (315.7 kV) and MW flow from FKR to BQN on 2L379 is less than 0.5 MW for more than 10 minutes (i.e.: no generation at FKR), the BQN RAS Logic IED will trip 2CB1 and 2CB2 (2L379) at BQN.

If BQN bus voltage exceeds 1.1 pu (315.7 kV) and MW flow from BQN to RDC is less than 15 MW for more than 15 minutes, the BQN RAS Logic IED will trip 2CB1 and 2CB4 (2L374) at BQN.

In both cases, breaker failure protection will not be initiated, since the actions of the breaker failure protection could exacerbate the overvoltage.

## 5.4 FKR Tripping for Loss of 2L374 when BQN 2CX1 Out of Service

If BQN 2CX1 is bypassed, and the MW flow from FKR to BQN is larger than 210 MW, and there is a multi-phase fault on 2L374 with fast clearing (zone 1 or telecom in service), the BQN RAS Logic IED will trip 2CB1 and 2CB2 (2L379) at BQN, as well as initiating breaker failure protection for both breakers.

If BQN 2CX1 is bypassed, and the MW flow from FKR to BQN is larger than 5 MW, and there is a multi-phase fault on 2L374 with slow clearing (zone 2 with telecom out of service), the BQN RAS Logic IED will trip 2CB1 and 2CB2 (2L379) at BQN, as well as initiating breaker failure protection for both breakers.

The BC Hydro Control Centre will notify AltaGas whenever the FKR generator AVR voltage set points need to be changed to meet system voltage requirements. AltaGas will comply with this operating request to the full extent of the generator control capabilities considering all safety, and electro-mechanical constraints and normal power factor requirements. The FKR AVRs will normally be set to regulate the BQN bus voltage at 293 kV (102%).

### 5.5 SKA 1L387 Expanded Tripping

When SKA 1D1CB5 is closed to bypass SKA 1CB4, 1L387 protection tripping is extended to trip SKA 5CB2, 2CB1, 2CB6, 6OCB3, 6OCB7 and 12CB34. This will de-energize SKA T1, T5 and T6. Note the same zone will be cleared (same breakers operated) if PY and SY protection for any of T1, T5 or T6 has operated. However, if a transformer protection operates it will, in addition to the above, open the appropriate transformer isolating disconnects, thereby "flagging" the fault zone to the dispatcher. If the above zone clears with no subsequent automatic disconnect operation, the problem can be assumed to have originated on 1L387.

## 6.0 ENERGIZING PROCEDURES

### 6.1 General

The following procedures are intended to minimize open-end voltages. With all reactors available no voltages above 550 kV should be encountered except in abnormal situations. During switching, voltages up to 579 kV may be tolerated for no more than five minutes providing a stable voltage no greater than 550 kV will result.

The TKW and SKA auto-var control should be “OFF” when TKW and SKA are operated in an islanded area or switching where auto shunt reactor operations may not be required.

**Note:** ***500 kV transformers must not be left connected to and energized simultaneously with a 500 kV line.***

### 6.2 Energizing 5L61

To be energized from WSN end only. No voltage problems with or without line reactor, if WSN is otherwise normal. WSN bus voltage at 510 kV is preferred and can be adjusted to assist matching voltages across GLN bus before synchronizing.

**Note**: The synchronizer at GLN has large voltage bandwidth (40 kV). Attempt to match voltages across the station before synchronizing. This will prevent a large voltage swing on KMO units and RTA system.

### 6.3 Energizing 5L62

#### 6.3.1 Energizing 5L62 from GLN (PREFERRED)

This is the preferred end to avoid voltage disturbance on the KIT bus. WSN voltage should be reduced to 515 kV prior to line energization. With GLN 5RX5 in service a rise of approximately 5 kV at GLN and a line open-end voltage of approximately 540 kV at TKW is expected.

If GLN 5RX5 is not available, with WSN voltage at 505 kV, a voltage rise of approximately 20 kV is expected at GLN and a line open-end voltage of approximately 545 – 550 kV is expected at TKW.

**Note**: The synchronizer at TKW has large voltage bandwidth (50 kV). Attempt to match voltages across the station before synchronizing. This will prevent a large voltage swing on KMO units and RTA system.

Providing the open-end voltage on 5L62 is at or below 550 kV, TKW 12RX3 can be used to connect through TKW T3 on the open end of 5L62, once the circuit is energized. A closer match of voltages across 5L62 to 5L63 at TKW will reduce the chances of a large bump to RTA and BCH customers.

Suggested switching to re-energize 5L62 with GLN 5RX5 OOS:

- Communicate closely with BCHCC and RTA during all switching.
- Starting from a configuration where TKW has been switched and TKW auto-var control "OFF".
- TKW T3 / T5 is off-loaded (1CB8 and 1CB9 open).
- TKW 5CB13 and 5CB23 open (5L62 open).
- TKW 5CB12 open to de-energize T3 / T5.
- Prior to re-energizing 5L62 WSN bus voltage to be lowered below 510 kV (500 kV or below if possible). GMS generators may be required to have enough generators to lower WSN bus voltage. Switch transmission lines OOS as required to use shunt reactors at WSN and KLY.
- GLN end to be used to energize 5L62 with GLN 5RX5 OOS. Open-end voltage should be about 545 - 550 kV.
- TKW 5CB23 closed to energize T3 / T5.
- TKW 12CB3 closed to put 12RX3 on load on open end of 5L62. Voltage should drop on 5L62 open end 18 – 20 kV.
- **Note**: TKW 12CB3 should be closed soon after T3 is energized.
  Do not leave T3 off load and energized at 550 kV.
- Match voltages across the open TKW 5CB13 as close as possible.
- To turn off tieline controller and pulse KMO units manually to match frequency with BCH system just prior to synchronizing back to BCH.
- TKW 5CB13 closed supervisory through synchronizer to synchronize to BCH.
- TKW 5CB12 closed ring complete.
- TKW T3 / T5 on load (1CB8 and 1CB9 closed).
- Restore normal operations with, including generation-shedding requirements for 2L101 and Peace 500 kV lines.
- TKW auto-var control can be turned on.

#### 6.3.2 Energizing 5L62 from TKW (OPTIONAL)

When energizing 5L62 with GLN 5RX5 connected it is expected that holding KIT at 285 kV will result in approximately 296 kV and 533 kV at SKA, 533 kV at TKW and 529 kV at GLN.

If TKW 5RX1 is not available, do not energize from TKW end.

If GLN 5RX5 is not available, do not energize from the TKW end.

Prior to conducting any switching on the islanded system, the BCHCC Operator must communicate with the System Operator to ensure that voltage fluctuations at SKA and TKW do not cause under frequency loading shedding at KIT.

### 6.4 Energizing 5L63

#### 6.4.1 Energizing 5L63 from TKW (PREFERRED)

Energizing from TKW (with WSN at 515 kV) and all 500 kV shunt reactors between TKW and WSN and two TKW 12 kV shunt reactors in service (TKW auto-var control "OFF") would result in 526 kV at TKW and 535 kV at the SKA open-end.

Energizing from TKW (with WSN at 510 kV) and all 500 kV shunt reactors between TKW and WSN and one TKW 12 kV shunt reactor in service (TKW auto-var control "OFF") would result in 536 kV at TKW and 545 kV at the SKA open-end.

Reducing WSN to 510 kV or below before energizing 5L63, and using TKW 12RX2 / 12RX3 (TKW auto-var control "OFF"), will assist in reducing the open end SKA voltage for proper synchronizing. During light load conditions extra GMS units may need to be started to help reduce the WSN voltage.

Energizing from TKW with WSN at 510 kV and TKW 5RX1 not available and one TKW 12 kV shunt reactor in service will result in 565 kV at TKW and 575 kV at the SKA open-end. With two TKW 12 kV shunt reactors in service and TKW 5RX1 not available will result in 548 kV at TKW and 558 kV at SKA open-end. Therefore, reduce WSN pre-energizing voltage to less than 510 kV if possible and use TKW 12RX2 and 12RX3 to lower the voltage (TKW auto-var control "OFF").

**Note**: The synchronizer at SKA has large voltage bandwidth (60 kV). Attempt to match voltages across the station before synchronizing. This will prevent a large voltage swing on KMO units and system.

**Note**: With TKW 5RX1 not available, prior to energizing 5L63 from TKW, the following precautions should be taken:

- Provided SKA T5 is available remove SKA T4 from service. (With 5L63 in service, loss of 2L99 will cause over-excitation of this bank)
- If available, run at least one, preferably two, RPG generators in the synchronous condenser mode.
- After synchronizing 5L63, hold the WSN voltage between 510 - 515 kV. For loss of 2L99 or 2L103 reduce the WSN voltage to 505 kV as soon as possible in order to keep TKW/SKA 500 kV voltage below 550 kV.

Energizing from TKW with WSN at 510 kV and both TKW 12RX2 and 12RX3 not available will result in 550 kV at TKW and 560 kV at SKA open-end. Therefore, if both TKW 12RX2 and 12RX3 are not available, then energize 5L63 from SKA end following the procedure in Section 6.4.2.

#### 6.4.2 Energizing 5L63 from SKA (OPTIONAL)

When energizing 5L63 with TKW 5RX1 it is expected that holding KIT at 285 kV will result in approximately 292 kV and 525 kV at SKA and 522 kV at TKW.

With TKW 5RX1 not connected, do not energize from the SKA end.

Prior to conducting any switching on the islanded system, the BCHCC Operator must communicate with the System Operator to ensure that voltage fluctuations at SKA do not cause underfrequency loading shedding at KIT.

**Note**: The synchronizer at TKW has large voltage bandwidth (50 kV). Attempt to match voltages across the station before synchronizing. This will prevent a large voltage swing on KMO units and system.

### 6.5 Energizing 2L99, 2L101 and 2L103

2L101 can only be energized from the SKA end. The line charging requirements are too high to energize from the RUP end.

The preferred ends for energizing 2L99 and 2L103 are SKA and MIN respectively. 2L99 and 2L103 can also be energized from MIN and KIT respectively.

### 6.6 Energizing 2L102

Refer to Section 3.4 for the normal configuration of reactors used for 2L102 operation.

Refer to SOO 5T-13 for detailed requirements on energizing the circuit with its related reactive equipment.

**6.7 Energizing 2L374**

Refer to SOO 5T-13 for detailed requirements on energizing the circuit with its related reactive equipment.

**6.8 Energizing 2L379**

Refer to SOO 5T-13 for detailed requirements on energizing the circuit with its related reactive equipment.

## 7.0 DE-ENERGIZING PROCEDURES

### 7.1 General Requirements

To minimize voltage fluctuation during switching, open breaker keying has been installed at SKA, TKW and GLN for 5L61, 5L62 and 5L63. Opening any one of 5L61, 5L62 and 5L63 circuits will result in islanding the Northwest Area system with RTA. Therefore, prior to switching any of these circuits:

- Block KMO and FKR generation shedding for loss of any 500 kV Peace line between GMS and KLY.
- The TKW and SKA auto-var control should be "OFF" when the stations are operated in an islanded area or switching where auto shunt reactor operations may not be wanted.
- Reduce MW and MVAR flow on the circuit to be switched to as low as possible. The RTA System Operator can now monitor the MW, MVAR, voltage and current on 5L61 (at GLN end), 5L62 (at TKW end) and 5L63 (at SKA end) through dial up equipment. This facility has been installed to assist the BCHCC Operator in reducing the MW and MVAR flows to minimum prior to taking one of the above circuits out of service.
- RTA System Operator switch voltage regulator transformer on each rectifier bay from "auto" to "manual".

### 7.2 De-energizing 5L61

**Refer to Section 7.1 General Requirements prior to de-energizing this circuit.**

Prior to switching the circuit, the following statuses are suggested:

- TKW 12RX2 and 12RX3 in-service, and
- SKA 12RX1 and 12RX2 in-service.
- TKW and SKA auto-var control "OFF".

Open the circuit at GLN then de-energize it at WSN.

Any subsequent switching of SKA shunt reactors should not be carried out without consulting the RTA System Operator.

### 7.3 De-energizing 5L62

**Refer to Section 7.1 General Requirements prior to de-energizing this circuit.**

Prior to switching the circuit, the following statuses are suggested:

- TKW 12RX2 and 12RX3 in-service and
- At least one of SKA 12RX1 and 12RX2 is in-service.

Open the circuit at TKW then de-energize it at GLN.

Any subsequent switching of SKA shunt reactors should not be carried out without consulting the RTA System Operator.

Suggested switching to de-energize 5L62 to remove GLN 5RX5:

- Communicate closely with BCH and RTA during all switching.
- TKW and SKA auto-var control "OFF".
- WSN bus voltage to be lowered below 515 kV.
- TKW 12RX2 and 12RX3 OOS (12CB2 and 12CB3 open).
- One SKA 12 kV reactor OOS.
- Zero MW and MVAR flow TKW to GLN on 5L62.
- 5L62 to be tripped from TKW to separate from RTA. Transfer trip to GLN (open breaker keying).
- RTA System Operator to go into frequency control on tieline controller to maintain 60.0 Hz or 60.3 Hz for outages longer than 1 hour.
- Wait 10 minutes for systems to stabilize. GLN 5RX5 disconnect to be open.

**7.4 <u>De-energizing 5L63</u>**
**Refer to Section 7.1 General Requirements prior to de-energizing this circuit.**

Prior to switching the circuit, the following statuses are suggested:

- At least one of TKW 12RX1 and 12RX2 must in-service, and
- SKA 12RX1 and 12RX2 (37.5 Mvar each) must be out of service
- SKA auto-var control "OFF".

Open the circuit at TKW then de-energize it at SKA. Any subsequent switching of SKA shunt reactors should not be carried out without RTA consultation.

**7.5 <u>De-energizing 2L99</u>**
**Refer to Section 7.1 General Requirements prior to de-energizing this circuit.**

Open at MIN first then de-energize at SKA.

**7.6 <u>De-energizing 2L101</u>**
Open at RUP first then de-energize at SKA.

**7.7 <u>De-energizing 2L103</u>**
Block generation shed at KMO for the loss of any Peace 500 kV lines.

Open at KIT first then de-energize at MIN.

**7.8 <u>De-energizing 2L102</u>**
Refer to SOO 5T-13 for de-energizing the line with its related reactive equipment.

**7.9 <u>De-energizing 2L374</u>**
Refer to SOO 5T-13 for de-energizing the line with its related reactive equipment.

**7.10 <u>De-energizing 2L379</u>**
Refer to SOO 5T-13 for de-energizing the line with its related reactive equipment.

**7.11 <u>De-energizing KMO-KIT Lines</u>**
Prior to de-energizing a KMO-KIT circuit, reduce the MW flow from KIT to MIN to 150 MW and ensure no more than one reactor on-line at each of SKA and TWA. SKA 500 kV bus voltage should be above 526 kV. All available KIT capacitors should be on line. RTA System Operator will raise KIT voltage prior to switching per RTA operating procedures.

## 8.0 <u>SYNCHRONIZING FACILITIES</u>

GLN, TKW, SKA, MIN and RPG 60 kV have full supervisory auto and local manual synchronizing facilities. KIT has local manual and automatic synchronizing available to the Control Operator.

## 9.0 BCH TO RTA TRANSFER LIMITS

The RTA tie is defined as the 287 kV circuit (2L103) between KIT and MIN Substations. These transfer limits are not System Operating Limits (SOL) for the internal path in the BCH-RTA transfer direction.

The purpose of his section is to codify known reliability limits and recommendations only. The limits set in this section are recommendations to aid Operators to manage within facility limits in the North Coast operating area.

RTA normally has no commercial agreement to receive energy from BC Hydro within these limits. Adhoc requests for energy need to be processed by TDSO Operations Planning, who will engage BC Hydro IPP Contracts to establish commercial contract for any adhoc request from RTA. TDSO Operations Planning will establish Operating Plans applying the operating requirements of Section 9.1 or additional requirements as needed to address transfer limits for adhoc contracts or agreements.

In normal operations or contingency responses, Operators must take steps to reduce the transfers to 0 MW for commercial operations. Refer to the Note 1 for BCH to RTA transfer under RTA's emergency operation conditions.

If a thermal or voltage limit for limit associated with area facilities is exceeded, pre or post contingency, or during switching, Operators must restore to the facilities capabilities within 30 minutes.

The transfer recommendations assessment is implemented by TSA-PM in the BC Hydro EMS.

| System Condition | Minette to Kitimat Transfer Recommendations | Comments |
|---|---|---|
| At least 7 KMO units online<br>**AND**:<br>System Normal, or<br>BQN 2CX1 OOS, or<br>2L102 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>L81-87 OOS, or<br>L82-88 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS, or<br>BQN 2RX231 OOS or<br>BQN 2RX232 OOS. | 0<br>(See Note 1 for emergency transfer support to RTA) | Consult Operations Planning for any special request for adhoc power. |

**Note 1**: Under normal operating conditions, MW power flow on 2L103 is always from KIT to MIN. But under certain contingencies in RTA system, BC Hydro can accept temporary reverse power flow on 2L103 as good utility practice. Based on BC Hydro's configurations note above and load conditions in North Coast transmission system, the RTA Operator must mitigate the impact the reverse power by the following procedures:

1. With 30 minutes the reversed power flow shall be reduced to 40 MW after a contingency event.
2. The reversed power flow shall be further reduced to 0 MW within next 90 minutes.

This operation procedure is subject to review and update as North Coast operating conditions, transmission configurations change from those in the above table, or as Operating Plans are established for any adhoc contract support.

## 9.1 BCH to RTA Transfer Limits (for Approved Adhoc Contracts)

BCH to RTA transfer limit specified below is developed based on the following system requirements:

**RTA System**

The following requirements are checked by TSA-PM:

- L81-87 and L82-88 in service,
- At least one of (KIT 2CX1 or KIT 2CX2) in service,
- Maximum KIT load: 695 MW, and
- At least 6 KMO units online

The following requirements are not monitored by TSA-PM, but shall be followed as much as possible:

- At least 2 shunt cap banks (2 x 32.4 MVAr) available at KIT,
- KMO units should be evenly distributed generation output, and
- No more than 2 generators connected to one step-up transformer.

**BCH System**

The following requirements are checked by TSA-PM:

- 5L61, 5L62 and 5L63 and all associated line reactors in service,
- BQN Auto-Var in-service (see Section 3.4)
- All SKA 12RX1, SKA 12RX2, TKW 12RX2, and TKW 12RX3 available,
- both SKA and TKW Auto-Var schemes are in-service, and
- SKA T1 and T2 in service.

The following requirements are not monitored by TSA-PM, but shall be followed as much as possible:

- SKA to BQN system shunt reactor requirements in Section 3.4.

With the above requirements, the **BCH to RTA transfer limit on 2L103 at MIN** is:

The least of:

a) 400 MW, or
b) 2L103_Norm_Rating, or
c) 2L103_Over_Rating (Attachment 1) - Max (KMO T1 MW, KMO T2 MW, KMO T3 MW, KMO T4 MW).

**Notes:**

- Refer to Section 11.6 for information regarding KMO step-up transformers and potential impacts on 2L103 thermal limits after loss of one of KMO step-up transformers.

Consult TDSO Operations Planning for BCH to RTA transfer limits if real time system condition is different from the system condition specified above.

## 10.0 RTA TO BCH TRANSFER LIMITS

The RTA tie is defined as the 287 kV circuit (2L103) between KIT and MIN. These transfer limits are not System Operating Limits (SOL) for the internal path in the RTA-BCH transfer direction. Rather, these transfer limits are the expected maximum transfers for commercial purposes given the available generation resources for studied topologies. TSA-PM implements a deadband for the transfers, to prevent unnecessary alarming as this limit is not an SOL.

If a thermal or voltage limit for associated area facilities is exceeded, pre or post contingency, or during switching, Operators must restore to the facilities ratings/capabilities within 30 minutes.

RTA is responsible for maintaining its potline net power factor between 0.98 to 1.0 lagging when Kitimat load is greater than 680 MW under all of the transfer scenarios in this section. When Kitimat load is less than or equal to 680 MW, the potline net power factor may be below 0.98 lagging in order to keep KMO unit terminal voltage to be higher than or equal to 0.95 pu.

The Transfer Limits assessment is implemented by TSA-PM in the BC Hydro EMS. TSA-PM also implements an alarm for monitoring RTA's potline net power factor.

Loads are defined below are calculated in real time and used in TSA-PM transfer limit and generation shedding requirement:

$L_{KIT}$ = – L81-87 KIT – L82-88 KIT – 2L103 KIT (Kitimat load)
$L_{MIN}$ = – 2L103 MIN – 2L99 MIN (Minette load)
$L_{KIT\_PL}$ is potline load at KIT (Kitimat potline load)
$L_{KIT\_AUX}$ = $L_{KIT}$ - $L_{KIT\_PL}$ (Kitimat auxiliary load)

Under normal operating conditions Kitimat load ($L_{KIT}$) is between 680 MW to 730 MW. Under special circumstances, Kitimat load will vary from 260 MW to 730 MW.

The **RTA to BCH Transfer Limit** is defined as:

$P_T$ (P_2L103) is the least of:

- 420 MW, or
- 2L103_Norm_Rating (Attachment 1), or
- 2L103 Transfer Limits under various system conditions listed in the following table:

**Table 10.1 RTA to BCH Transfer Limits**

| **System Conditions** | | **KMO online units** | **RTA to BCH Transfer Limit (Note 1)** |
|---|---|---|---|
| System Normal. or<br>BQN 2CX1 OOS (**Note 2**), or,<br>2L102 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>L81-87 OOS, or<br>L82-88 OOS, or | | 7 or 8 | 420 MW |

| | | | |
|---|---|---|---|
| (KIT 2CX1 and 2CX2) OOS | | | |
| (L81-87 and KIT 2CX1) OOS **(Note 3),** or<br>(L82-88 and KIT 2CX2) OOS **(Note 3)** | | 7 or 8 | 350 MW |
| System Normal ($L_{KIT}$ > 300 MW)<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS | | 6 | 0 MW |
| System Normal ($L_{KIT}$ <= 300 MW) | | 6 | 280 MW<br>(Note 5) |

**Note 1**: The RTA to BCH transfer limits specified in this section are only applicable to these pre-defined System Conditions and KMO 6/7/8 units on line scenarios in Table 10.1. Scenarios not covered in Table 10.1 should be treated as 0 MW Transfer Limit in real time, as the expected surplus generation above $L_{KIT}$ should be 0 MW. Consult Operations Planning for operational instructions, for any transfer request under scenarios outside of these specified in Table 10.1, as these are presently unsupported conditions.

**Note 2**: Refer to Section 5.4 - FKR Tripping for Loss of 2L374 when BQN 2CX1 Out of Service for information regarding BQN local RAS scheme with BQN 2CX1 OOS.

**Note 3**: This topology is an outage to one of the KIT transmission lines and an outage to the series capacitor on the other line (i.e. an outage to the series capacitor on the line that is remaining in service). This is a transient stability limit.

**Note 4**: Removed.

**Note 5**: Only if KIT load ($L_{KIT}$) below or equal to 300 MW.

## 11.0 RAS: DTT SCHEMES AND RESTRICTIONS

### 11.1 General

The subsections below provide details on Direct Transfer Trip schemes (DTT), Operating Restrictions, generation Reliability Must Run (RMR) requirements and Minimum Unit On-line (MUO) requirements in the NC Area. The North Coast RAS implementation is detailed in Attachment 3. The RAS includes controllers located at Kitimat and Skeena. The controllers are used to apply RAS arming for the KMO generation and load shedding schemes, for FKR IPP generation shedding, and RDC load shedding. Generation Shedding is further detailed in Section 12. The RAS arming is set in the BC Hydro EMS by TSA-PM.

When the NC area load is greater than the area generation, the NC could experience underfrequency after the loss of any 500 kV transmission line between Williston and Skeena Substation. DTT schemes on 2L103 and 2L99 are installed to minimize underfrequency that can cause wide area black-outs after the loss of 5L61, 5L62 or 5L63, in the islanded area that forms. The DTT of the lines preserves RTA generation and load, and possibly MIN load, in order to expedite restoration of the other area loads. Further, should RTA internal transmission lines also trip, Pot Line load shedding may occur. In addition, underfrequency shedding is also installed at Red Chris Mine load and is as part of direct transfer tripping RAS.

### 11.2 Direct Transfer Tripping of 2L99/2L103 and/or Red Chris Mine Load Shedding

Based on the availability of KMO units online, L81-87/L82-88 status, KIT series capacitor status and RDC load level, nomograms are developed for DTT of 2L99, or 2L103, and/or RDC Load Shed arming requirements. These nomograms can be found in Attachment 4.

### 11.3 Forrest Kerr IPP Minimum Units Online (MUO) Requirement

The FKR IPP's small hydro units are connected to bulk system via 380 kms of 287 kV transmission lines from collector sites (FKR, VOL, and MCY). There may be temporary overvoltage issues due to machine self-excitation when opening 2L102 at SKA. A Reliability Must Run (RMR) requirement for Forrest Kerr IPP units has been developed to mitigate impacts.

When FKR/VOL/MCY are generating, they will be required to meet the minimum MVA unit's online requirements as listed in the table below. This minimum amount of FKR/VOL/MCY generator MVA is required on line to provide as a backup for the fast acting direct transfer trip (DTT) protection. This DTT is necessary to avoid temporary overvoltage (TOV) and surge arrestor failure, due to machine self-excitation, while the generators are islanded prior to power quality protection taking effect.

The DTT will be sent to FKR/VOL/MCY following loss of BQN 2B3 or 2L102, as a result of three pole protection trips, unsuccessful single pole reclosing or an open terminal at SKA.

The following table summarizes the minimum MVA online required at FKR/VOL/MCY generation clusters for different system configurations when Forrest Kerr IPP is generating (" ✔ " means in service and "✘" means out of service).

**Table 11.3 Reliability Must Run Requirements at Forrest Kerr IPP**

| System Condition / Equipment Availability | SKA 287 kV Substation | | BQN 287 kV Substation | | | | Iskut Extension | FKR/VOL/MCY (Note 1) |
|---|---|---|---|---|---|---|---|---|
| | 2RX1 (35 MVAR) | 2RX2 (35 MVAR) | 2RX231 (35 MVAR) | 2RX232 (35 MVAR) | 2RX22 (15 MVAR) | 2RX25 (20 MVAR) | 2L374 (BQN – TAT - RDC line) | Minimum Machine MVA required |
| 1 | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ≥ 30 MVA |
| 2 | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ≥ 65 MVA |
| 3 | ✓<br>✗ | ✗<br>✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ≥ 65 MVA |
| 4 | ✓<br>✗ | ✗<br>✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ≥ 100 MVA |
| 5 | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ≥ 15 MVA |
| 6 | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ≥ 15 MVA (Note 5) |
| 7 | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ≥ 45 MVA |
| 8 | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ≥ 60 MVA |
| 9 | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ≥ 80 MVA |
| 10 | ✓<br>✗ | ✗<br>✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ≥ 115 MVA |
| 11 | ✓<br>✗ | ✗<br>✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ≥ 30 MVA |
| 12 | ✓<br>✗ | ✗<br>✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ≥ 65 MVA |
| 13 | ✓<br>✗ | ✗<br>✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ≥ 15 MVA |
| 14 | ✓<br>✗ | ✗<br>✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ≥ 15 MVA (Note 5) |
| 15 | ✓<br>✗ | ✗<br>✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ≥ 45 MVA |
| 16 | ✓<br>✗ | ✗<br>✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ≥ 60 MVA |
| 17 | ✓<br>✗ | ✗<br>✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ≥ 80 MVA |
| 18 | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ≥ 65 MVA |
| 19 | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ≥ 100 MVA |

Note 1: Forrest Kerr (FKR) site has nine units, each at 26.1 MVA, Volcano Creek (VOL) site has two units, each at 10 MVA, and McLymont (MCY) site has three units, each at 26.2 MVA.

(notes continue on next page)

Note 2: If in real time operation the system condition / equipment availability does not match the above 19 cases, TSA-PM will issue an alarm “MUST NOT OPERATE IN THIS CONDITION”.

Note 3: If there are no FKR, VOL, and MCY units online, then the above Minimum Machine MVA will not apply.

Note 4: Any combination of line and reactors out of service not identified in the table are considered high risk and an unacceptable risk to equipment. In emergency situations, however, such high risk combinations must be reported to **Operations Planning**.

Note 5: Abnormal configuration used only during emergency system conditions. (Refer to LOO 3T-BQN-01 Section 4.0).

## 11.4 Operational Restrictions and RMR Requirements for 2L99 or 2L103 Contingency

| System Condition | Operational Instructions / Restrictions |
|---|---|
| System Normal, or<br>BQN 2CX1 OOS, or<br>(KIT 2CX1 and 2CX2) OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>(L81-87 and KIT 2CX1) OOS, or<br>(L82-88 and KIT 2CX2) OOS, or<br>L81-87 OOS, or<br>L82-88 OOS | If FKR/VOL/MCY is in service, then the units online requirement is:<br>• If RDC load is normal (>= 25 MW), FKR/VOL/MCY units online shall meet the RMR requirements in Section 11.3.<br>• If RDC load is low (< 25 MW), FKR/VOL/MCY must have the greater of:<br>    o 2 FKR/MCY units online, or<br>    o RMR requirements in Section 11.3.<br><br>If FKR, VOL, and MCY are OOS, then<br>• If RDC load is normal (>= 25 MW), 2L379 (BQN to FKR) can be in service<br>• If RDC load is low (< 25 MW), 2L379 shall be taken out immediately post contingency to mitigate high voltage at BQN. (See recommended instructions in LOO 3T-BQN-01 Section 4.0) |
| SKA T1 OOS, or<br>SKA T2 OOS | If FKR/VOL/MCY is in service, then the unit online requirement is the greatest of:<br>• 2 FKR/MCY units online, if RDC load is normal (>= 25 MW), or<br>• 4 FKR/MCY units online, if RDC load is low (< 25 MW), or<br>• RMR requirements in Section 11.3<br>If FKR, VOL, and MCY are not in service or do not have enough units online, consult Operations Planning for operational instructions. |
| BQN 2RX231 OOS or BQN 2RX232 OOS | If FKR/VOL/MCY is in service, then the units online requirement is the greater of:<br>• Number of FKR/MCY units must be online is<br>    6 - 0.067 * 2L374 BQN (RDC Load), or<br>• RMR requirements in Section 11.3<br><br>**NOTE: If the calculated number of units online is not an integer value, it should be rounded up to the closest higher integer value.**<br><br>If FKR, VOL, and MCY are not in service or do not have enough units online, consult Operations Planning for operational instructions. |

Notes

(1) "RDC load is normal" means the load is greater than or equal to 25 MW
(2) "RDC load is low" means the load is less than 25 MW.
(3) Using 2L374 BQN flow as proximity of RDC load. A ± 5 MW deadband can be applied to avoid fluctuation in real time operations.
(4) Consult Operations Planning for operational instructions for any system conditions not covered in the above table.

**Note: Failure to comply with the Operational Instructions/Restrictions in the above table may result in voltages above 1.1 pu in BQN-RDC system after loss of 2L99 or 2L103.** To avoid such high voltages after contingency occurrence, BQN bus voltage should be kept at 1.07 pu or lower. In the case of high voltages after contingency, Operators should manually bring down the voltages by reducing the FKR/MCY/VOL unit terminal voltages and/or adding more FKR/MCY/VOL units online. This recommendation is not implemented in/by TSAPM.

## 11.5 <u>Operational Restrictions and RMR Requirements with 2L99 or 2L103 Out of Service</u>

When either 2L99 or 2L103 is OOS, 2L102 can only be operated under the following conditions:

- If FKR/VOL/MCY is in service, then the RMR Requirement is the greater of:
  - 4 FKR/MCY units online, or
  - the RMR requirements in Section 11.3.
- Consult Operations Planning for operational instructions if FKR, VOL, and MCY are not in service or do not have enough units online. Or refer to LOO 3T-FKR-01 for recommendations on operational considerations.

For 2L99 or 2L103 OOS, it is recommended to keep at least two KMO units un-armed to mitigate the over voltage and underfrequency issues for loss of potline load.

- For 2L99 OOS, RTA is requested to have the 2 unarmed units approximately matched with RTA load (KIT_aux + KMO_aux + 2L103_MW_Load + margin). This is an operating guideline.
- For 2L103 OOS, RTA is requested to have the 2 unarmed units approximately matched with RTA load (KIT_aux + KMO_aux + margin). This is an operating guideline.
- Use a recommended margin of 10-30 MW. Operations simulation studies show this margin should not inadvertently trip units when frequency relays are set at 62 Hz (see Section 13.2.2).

## 11.6 <u>Operational Restrictions for Loss of One KMO Step-up Transformer</u>

There are four Generator Step Up transformers (GSU) and eight generation units at KMO generation substation. Under normal operation, two units are connected to one GSU. However, three units may be connected to one GSU if one of the 4 GSUs is out of service for maintenance or any other reasons.

Loss of one GSU could cause overload on 2L103 during summer period, especially if one of KMO GSU is out of service, and the fault is on the GSU with three generation units connected.

To prevent the overload, limit:

- Max (KMO T1 MW, KMO T2 MW, KMO T3 MW, KMO T4 MW) + 2L103 MIN <= 2L103_Over_Rating,
  where KMO T1 refers to Bank 1/2, KMO T2 refers to Bank 3/4, KMO T3 refers to Bank 5/6, and KMO T4 refers to Bank 7/8.

If TSA-PM alarm "VIOLATION_2L103_THER_RATING", the BC Hydro Control Centre staff should notify the RTA System Operator, and RTA System Operator shall take the following actions:

- Reduce KMO generation output from the units that are connected to the GSU with the largest MW loading, and/or
- Increase flow from KIT to MIN on 2L103.

### 11.7 Operational Instructions When 5L61, 5L62, or 5L63 Out of Service

Consult Operations Planning for operational instructions when 5L61, 5L62, or 5L63 is out of service. TSA-PM shall issue an alarm message under these system conditions, and disarm generation shedding and/or DTT requirements, for the following contingencies:

- 2L101 or 2L100 or SKA T1 or SKA T2 contingency
- 2L102 (1P) contingency
- 2L99 contingency
- 5L61, 5L62, or 5L63 contingency
- 5L61 (1P), 5L62 (1P), or 5L63 (1P) contingency
- Loss of KIT potline load
- L81-87 or L82-88 contingency
- L81-87 and L82-88 contingency
- KMO North Bus or South Bus contingency (NOT IMPLEMENTED IN TSA-PM)
- Keep at least two KMO units un-armed to mitigate the over voltage issue for loss of potline load (NOT IMPLEMENTED IN TSA-PM)
- 2L100, or 2L107, or 2L100 and 2L107 contingency

# 12.0 RAS: GENERATION SHEDDING AND LINE TRIPPING REQUIREMENTS

## 12.1 North Coast Remedial Action Scheme

### 12.1.1 General Information

The North Coast RAS is a Wide Area Protection Scheme. There are two sets of controllers, one located at SKA, and another one located at KIT. The North Coast RAS will shed generation at FKR, VOL, MCY, and KMO, or smelter load at KIT following various integrated electric system contingencies. RAS arming is performed automatically at the BC Hydro Control Centre. Refer to Attachment 3 for detailed description of North Coast RAS.

The RAS communication and control equipment must normally be in service. BC Hydro approval is required prior to removing from service any equipment associated with the RAS. The PY or SY RAS control equipment at KIT the power line carrier teleprotection channels between KIT-KMO are fully redundant using a quad PLC system.

### 12.1.2 Generation Shedding at Forrest Kerr IPP

At the FKR plant site there are 9 generator units aggregated into six generation shedding groups. Each group consists of 1 to 2 generator units. For various system contingencies, these groups may be selected for shedding. Generation shedding has been implemented by tripping group(s), through individual unit circuit breakers.

At the VOL site there are 2 units. Generation shedding application at Volcano site has been implemented by tripping it as one group, through two unit circuit breakers.

At the MCY site, there are 3 units. Generation shedding application will be implemented by tripping it as one group, through three unit circuit breakers.

There are eight FKR/MCY/VOL generation shedding groups available. Components of the 8 groups are shown as follows:

- Group 1: FKR G1,G2
- Group 2: FKR G4,G5
- Group 3: FKR G7,G8
- Group 4: MCY G1, G2, G3
- Group 5: VOL G1, G2
- Group 6: FKR G3
- Group 7: FKR G6
- Group 8: FKR G9

NOTE: (1) VOL units should be armed first if they are sufficient to meet the generator shedding requirement; otherwise MCY units will be armed first and the remaining will be shed from VOL. If further shedding is required, FKR units will be armed after VOL and MCY; (2) If the pre-contingency online units at FKR/MCY are less than the post-contingency min units online requirements, do not shed VOL.

### 12.1.3 Generation Shedding at KMO

There are 8 units at KMO available for generation shedding for various system contingencies. KMO G2 and G6 have black start capability and normally connect to KMO station services. In accordance with RTA’s request and BCH’s agreement

- KMO G2 shall be the last unit to be armed for shedding.
- KMO G6 is the first unit to be armed for shedding if its output is above 90 MW because of its poorer dynamic performance.

## 12.2 Generation Shedding Application at KMO and FKR IPP

The North Coast Gen Shed RAS is capable of selecting individual unit at KMO and groups of units at FKR, VOL and MCY for generation shedding upon contingencies. The arming determined by TSA-PM is based on the equations in the following tables.

### 12.2.1 2L101 or SKA T1 or SKA T2 Contingency

The following Notes 1 to 8 are applicable in Section 12.2.1 as specified in each table:

Note 1: Post generation shedding minimum units on line requirement at Forrest Kerr IPP: 3 at FKR/MCY if armed at FKR/MCY/VOL.

Note 2: Post generation shedding minimum units on line requirement at KMO: 4 if armed at KMO for certain system conditions.

Note 3: Minimum Units On-line requirements are given priority over generation shedding for FKR/VOL/MCY.

Note 4: The total armed generation shedding amount must be less than the loading of 5L63 SKA.

Note 5: Number of Harmonic Filters at KIT has to be reduced accordingly when KIT load is reduced. This is to maintain KMO generator terminal voltage to be at least 0.95 p.u. in order to achieve acceptable transient performance. If an alarm is received, RTA needs to be notified.

Note 6: KMO G6 must be the first unit to be armed if its output is above 90 MW and generation shedding is required by TSA-PM. This is to avoid negative impact on the transient stability because KMO G6 has the worst dynamic performance comparing with other KMO units. Both KMO G2 and G6 normally connect to KMO station services. KMO G2 is always kept online post generation shedding to supply station load. If KMO G2 is offline and generation shedding at KMO is required, G6 shall not be armed and its output needs to be less than 90 MW. This is necessary to avoid the loss of station service on generation shedding.

Note 7: Post generation shedding minimum units on line requirement at KMO: 3 if armed at KMO for certain system conditions.

Note 8: BQN 2RX22 must be switched in service when generation shedding at FKR/MCY/VOL is required AND BQN 2RX231 or 2RX232 is out of service.

**Table 12.2.1.1 – KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of SKA T1 or SKA T2 under Various System Conditions**

| System Condition | Generation Shedding Requirements at KMO | Generation Shedding Requirements at FKR/MCY/VOL | Notes |
|---|---|---|---|
| System Normal, or<br>BQN 2CX1 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>KIT 2CX1 AND 2CX2 OOS, | 3.4* P_2L103 KIT + 1.6 * $L_{KIT}$ – 1740 MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 2, 3, 5, and 6 |
| 87L OOS, or<br>88L OOS | 3.3* P_2L103 KIT + 1.8 * $L_{KIT}$ – 1670 MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 2, 3, 5, and 6 |
| 87L OOS and KIT 2CX1 OOS, or<br>88L OOS and KIT 2CX2 OOS | 1.5* (P_2L103 KIT – 50) MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 3, 5, 6 and 7 |
| BQN 2RX231 OOS, or,<br>BQN 2RX232 OOS | 3.4* P_2L103 KIT + 1.6 * $L_{KIT}$ – 1740 MW | 1.0 * (P_2L102 BQN – 120) MW | Note 2, 3, 5, 6 and 8 |
| 2L102 OOS | 2.3* P_2L103 KIT + 1.2 * $L_{KIT}$ – 1390 MW | Not required | Note 2, 5, and 6 |
| 2L103 OOS, or 2L99 OOS | Not required | Not required | |

**Table 12.2.1.2 - KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of 2L101 under Various System Conditions**

| System Condition | Generation Shedding Requirements at KMO | Generation Shedding Requirements at FKR/MCY/VOL | Notes |
|---|---|---|---|
| System Normal, or<br>BQN 2CX1 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>KIT 2CX1 AND 2CX2 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS | 3.4* P_2L103 KIT + 1.6 * $L_{KIT}$ – 1740 MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 2, 3, 5, and 6 |

| | | | |
|---|---|---|---|
| 87L OOS, or<br>88L OOS | 3.3* P_2L103 KIT + 1.8 * $L_{KIT}$ – 1670 MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 2, 3, 5, and 6 |
| 87L OOS and KIT 2CX1 OOS, or<br>88L OOS and KIT 2CX2 OOS | 1.5* (P_2L103 KIT – 50) MW | 1.2 * (P_2L102 BQN – 90) MW | Note 1, 3, 5, 6 and 7 |
| BQN 2RX231 OOS, or,<br>BQN 2RX232 OOS | 3.4* P_2L103 KIT + 1.6 * $L_{KIT}$ – 1740 MW | 1.0 * (P_2L102 BQN – 120) MW | Note 2, 3, 5, 6 and 8 |
| 2L102 OOS | 2.3* P_2L103 KIT + 1.2 * $L_{KIT}$ – 1390 MW | Not required | Note 2, 5, and 6 |
| 2L103 OOS, or<br>2L99 OOS | Not required | Not required | |

**Table 12.2.1.3 – Removed**

**Table 12.2.1.4 – Removed**

**Table 12.2.1.5 – Removed**

**Table 12.2.1.6 – Removed**

**Table 12.2.1.7 – KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of 2L101 or SKA T1 or SKA T2 with 6 KMO Units in Operation (Note 1, 2, 3, and 5)**

| System Condition | P_2L103 KIT(MW) | KIT Load $L_{KIT}$ (MW) | Generation Shedding Requirements at FKR/MCY/VOL | Generation Shedding Requirements at KMO |
|---|---|---|---|---|
| System normal with 6 KMO units in operation | P_2L103 KIT ≤ 200 | 150 < $L_{KIT}$ <300 | Shed FKR/VOL/MCY down to 140 MW, select VOL first, and then MCY second for shedding | No generation shedding required |

| System Condition | P_2L103 KIT(MW) | KIT Load $L_{KIT}$ (MW) | Generation Shedding Requirements at FKR/MCY/VOL | Generation Shedding Requirements at KMO |
|---|---|---|---|---|
| | 200 < P_2L103 KIT ≤ 280 | $150 < L_{KIT} < 300$ | Shed FKR/VOL/MCY down to 140 MW, select VOL first, and then MCY second for shedding | Shed two units of at least 200 MW |

**Note for Table 12.2.1.7: This is a temporary operation procedure and will be reviewed and updated in a future revision.**

**Table 12.2.1.8 – Removed**

**Table 12.2.1.9 – Removed**

**Table 12.2.1.10 – KMO/FKR/VOL/MCY Generation Shedding Requirements for SKA T1 AND T2 N-1-1 Contingency (Note 1, 2, 3, 4, 5, and 6,)**

| System Condition | Contingencies | Generation Shedding Requirements |
|---|---|---|
| SKA T1 OOS | SKA T2 | Shed at FKR/VOL/MCY/KMO: 5L63 SKA – 135 MW<br>If arming the available generation at FKR/VOL/MCY can reduce KMO number of units for shedding, then these generation units shall be armed first |
| SKA T2 OOS | SKA T1 | Shed at FKR/VOL/MCY/KMO: 5L63 SKA – 135 MW<br>If arming the available generation at FKR/VOL/MCY can reduce KMO number of units for shedding, then these generation units shall be armed first. |

### 12.2.2 2L102 (1P) Contingency

**Table 12.2.2– FKR/VOL/MCY Generation Shedding Requirements for 2L102 (1P) Faults**

| System Condition | Generation Shedding Requirements at FKR/MCY/VOL |
|---|---|
| System Normal, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>87L OOS, or<br>88L OOS | 1.0 * P_2L102 BQN + 0.06 * P_2L103 KIT – 210 MW |
| BQN 2CX1 OOS | 1.2 * (P_2L102 BQN – 160 MW) |
| L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS | 1.02 * P_2L102 BQN + 0.11 * P_2L103 KIT – 210 MW |
| 2L103 OOS or 2L99 OOS | 1.4 * (P_2L102 BQN – 210 ) MW |

Note 1: Select VOL and MCY first prior to FKR.

### 12.2.3 2L99 Contingency

**Table 12.2.3.1 – FKR/VOL/MCY Generation Shedding Requirements for 2L99 Contingency**

| System Condition | Generation Shedding Requirements at FKR/MCY/VOL |
|---|---|
| System Normal, or<br>L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>L81-87 OOS, or<br>L82-88 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS | 1.0 * P_2L102 BQN + 0.2 * P_2L103 KIT – 310 MW |
| SKA T1 or T2 OOS | 2.0 * P_2L102 BQN + 0.4 * P_2L103 KIT – 630 MW |
| BQN 2CX1 OOS | 2.1 * (P_2L102 BQN – 180) MW |

Note 1: Post shedding requirement at Forrest Kerr IPP - If generation shedding is required, keep at least 2 FKR/MCY units on-line post-shedding. Minimum Units On-line requirements are given priority over generation shedding for FKR/VOL/MCY.
Note 2: When FKR/VOL/MCY output or 2L103 transfer is high, transient dip in BQN voltage might reach 0.6 pu. It should be noted that this low transient voltage may cause some performance issues for RDC load, especially induction machines. However, if shedding all FKR/VOL/MCY units, transient over-voltage may occur which results in whole FKR-BQN-RDC area tripped/blacked out.
Note 3: Select VOL and MCY first prior to FKR.

**Table 12.2.3.2 – KMO Generation Shedding Requirements for 2L99 contingency**

| System Condition | Generation Shedding Requirement |
|---|---|
| | |
| System Normal, or<br>2L102 OOS, or<br>BQN 2CX1 OOS, or<br>L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>L81-87 OOS, or L82-88 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or KIT 2CX2 OOS, or<br>SKA T1 OOS, or SKA T2 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | Shed at KMO: 2L99 MIN – 135 MW |
| 2L103 OOS | No gen shed at KMO required. |

Note 1: Keep at least four KMO units post generation shedding.
Note 2: The total armed generation shedding amount at KMO must be less than 2L99 MIN.
Note 3: If TSA-PM alarms “insufficient shedding”, the BC Hydro Control Centre staff must request Rio Tinto Aluminum to re-dispatch generation output from KMO units.

### 12.2.4 Loss of 500 kV Transmission Lines – 5L61/5L62/5L63

**Table 12.2.4 – FKR/VOL/MCY/KMO Generation Shedding Requirements for Loss of 500 kV Transmission Lines**

| System Condition | CONTINGENCY | SHEDDING REQUIREMENTS |
|---|---|---|
| System Normal | 5L61 (3P) | Shed at FKR/VOL/MCY/KMO: 5L61 GLN – 135 MW<br><br>Note 1 – 6 |
| | 5L62 (3P) | Shed at FKR/VOL/MCY/KMO: 5L62 TKW – 135 MW<br><br>Note 1 – 6 |
| | 5L63 (3P) | Shed at FKR/VOL/MCY/KMO: 5L63 SKA – 135 MW<br><br>Note 1 – 6 Except Note 2 |

Continued on next page

**Table 12.2.4 Continued**

| System Condition | CONTINGENCY | SHEDDING REQUIREMENTS |
|---|---|---|
| BQN 2CX1 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS, or<br>L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>L81-87 OOS, or L82-88 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | 5L61 (3P) | Shed at FKR/VOL/MCY/KMO: 5L61 GLN – 135 MW<br>Note 1 - 6 |
| | 5L62 (3P) | Shed at FKR/VOL/MCY/KMO: 5L62 TKW – 135 MW<br>Note 1 - 6 |
| | 5L63 (3P) | Shed at FKR/VOL/MCY/KMO: 5L63 SKA – 135 MW<br>Note 1 - 6 Except Note 2 |
| 2L102 OOS | 5L61 (3P) | Shed at KMO: 5L61 GLN – 135 MW<br>Note 1 - 6 Except Note 2 |
| | 5L62 (3P) | Shed at KMO: 5L62 TKW – 135 MW<br>Note 1 - 6 Except Note 2 |
| | 5L63 (3P) | Shed at KMO: 5L63 SKA – 135 MW<br>Note 1 - 6 Except Note 2 |
| 2L103 OOS, or 2L99 OOS | 5L61 (3P)<br>5L62 (3P)<br>5L63 (3P) | North Coast islanded system would be blacked out |

Note 1: Post generation shedding minimum units on line requirement: FKR/MCY: 3 if armed at FKR/MCY/VOL; KMO: 4 if armed at KMO.
Note 2: Keep at least one of TKW 12RX2 and 12RX3 on line if generation shedding at FKR/VOL/MCY/KMO is armed for loss of 5L61 or 5L62. It is to control transient voltage at BQN/TAT to be less than 1.1 pu for 5L61 and 5L62 contingencies.
Note 3: If arming the available generation at FKR/VOL/MCY can reduce KMO number of units for shedding, then these generation units shall be armed first.
Note 4: The total armed generation shedding amount must be less than the loading of the subject contingency circuit.
Note 5: Minimum Units On-line requirements are given priority over generation shedding for FKR/VOL/MCY.
Note 6: If TSAPM alarms “insufficient shedding”, then BC Hydro Control Centre staff must request KMO and/or AltaGas Operators to re-dispatch generation among KMO and FKR IPP if applicable.

### 12.2.5 Single Phase Fault on 500 kV Transmission Lines – 5L61/5L62/5L63 (1P)

**Table 12.2.5 – FKR/VOL/MCY Generation Shedding Requirements for Single Phase Fault on 500 kV Transmission Lines**

| System Condition | CONTINGENCY | SHEDDING REQUIREMENTS |
|---|---|---|
| System Normal, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | 5L63 (1P) | Shed at FKR/VOL/MCY: 0.85 * 2L102 BQN + 0.92 * 2L103 KIT – 402 MW |
| | 5L62 (1P) | Shed at FKR/VOL/MCY: 0.63 * 2L102 BQN + 0.69 * 2L103 KIT – 301 MW |
| | 5L61 (1P) | Shed at FKR/VOL/MCY: 0.59 * 2L102 BQN + 0.69 * 2L103 KIT – 339 MW |
| BQN 2CX1 OOS | 5L63 (1P) | Shed at FKR/VOL/MCY: 0.85 * 2L102 BQN + 0.81 * 2L103 KIT – 359 MW |
| | 5L62 (1P) | Shed at FKR/VOL/MCY: 0.63 * 2L102 BQN + 0.61 * 2L103 KIT – 269 MW |
| | 5L61 (1P) | Shed at FKR/VOL/MCY: 0.55 * 2L102 BQN + 0.56 * 2L103 KIT – 272 MW |
| KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or<br>KIT 2CX2 OOS | 5L63 (1P) | Shed at FKR/VOL/MCY: 0.80 * 2L102 BQN + 0.93 * 2L103 KIT – 365 MW |
| | 5L62 (1P) | Shed at FKR/VOL/MCY: 0.60 * 2L102 BQN + 0.70 * 2L103 KIT – 273 MW |
| | 5L61 (1P) | Shed at FKR/VOL/MCY: 0.54 * 2L102 BQN + 0.64 * 2L103 KIT – 280 MW |
| L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>L81-87 OOS, or<br>L82-88 OOS | 5L63 (1P) | Shed at FKR/VOL/MCY: 0.76 * 2L102 BQN + 0.94 * 2L103 KIT – 307 MW |
| | 5L62 (1P) | Shed at FKR/VOL/MCY: 0.45 * 2L102 BQN + 0.56 * 2L103 KIT – 183 MW |
| | 5L61 (1P) | Shed at FKR/VOL/MCY: 0.34 * 2L102 BQN + 0.47 * 2L103 KIT – 170 MW |
| SKA T1 OR T2 OOS | 5L63 (1P) | Shed at FKR/VOL/MCY: 0.80 * 2L102 BQN + 0.87 * 2L103 KIT – 356 MW |
| | 5L62 (1P) | Shed at FKR/VOL/MCY: 0.61 * 2L102 BQN + 0.67 * 2L103 KIT – 278 MW |

| | | |
|---|---|---|
| | 5L61 (1P) | Shed at FKR/VOL/MCY: 0.53 * 2L102 BQN + 0.63 * 2L103 KIT – 286 MW |
| 2L102 OOS | 5L63 (1P) | No issues identified |
| | 5L62 (1P) | No issues identified |
| | 5L61 (1P) | No issues identified |
| 2L99 OOS, or 2L103 OOS | 5L63 (1P) | No Generation Shedding Required |
| | 5L62 (1P) | No Generation Shedding Required |
| | 5L61 (1P) | No Generation Shedding Required |

Note: General post shedding requirement at Forrest Kerr IPP - If generation shedding is required, keep at least 2 FKR/MCY units on-line post-shedding. Minimum Units On-line requirements are given priority over generation shedding for FKR/VOL/MCY. An alarm shall be generated and BCHCC Operators shall adjust generation patterns at FKR/VOL/MCY.

### 12.2.6 Loss of Kitimat Potline Load

| System Condition | SHEDDING REQUIREMENTS (Note 1,2, 3 and 4) |
|---|---|
| System Normal, or 2L102 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or KIT 2CX2 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | Shed at KMO the greater of:<br>• 0.84 * KMO_Gen + 0.35 * $L_{KIT\_PL}$ – 590 MW [transient stability]<br>• 1.05 * (2L103 KIT + $L_{KIT\_PL}$ – 2L103_Over_Rating) MW<br>• KMO_Gen – 500 [avoid 32LS mis-operation] MW<br>Note: $L_{KIT\_PL}$ is KMP potline load at KIT. |
| L81-87 OOS, or L82-88 OOS, or<br>SKA T1 OOS, or SKA T2 OOS, or<br>BQN 2CX1 OOS | Shed at KMO the greater of:<br>• 0.74 * KMO_Gen + 0.35 * $L_{KIT\_PL}$ – 500 [transient stability] MW<br>• 1.05 * (2L103 KIT + $L_{KIT\_PL}$ – 2L103_Over_Rating) MW<br>• KMO_Gen – 500 [avoid 32LS mis-operation] MW |
| L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or | Shed at KMO the greater of:<br>• 0.73 * KMO_Gen + 0.28 * $L_{KIT\_PL}$ – 450 [transient stability] MW<br>• 1.05 * (2L103 KIT + $L_{KIT\_PL}$ – 2L103_Over_Rating) MW<br>• KMO_Gen – 500 [avoid 32LS mis-operation] MW |
| 2L99 OOS | Consult Operations Planning for operational instructions |
| 2L103 OOS | RTA will be islanded on its own |

Note 1: Number of Harmonics Filters at KIT has to be reduced accordingly when KIT load is reduced. This is to maintain KMO generator terminal voltage to be at least 0.95 p.u. in order to achieve acceptable transient performance and maintain post-contingency system voltage.

Note 2: Currently the cascading outage of KIT rectifier transformers, which will lead to loss of KMP potline load, will not trigger the contingency signal “loss of KIT potline load”. Refer to Section 13.3 – ‘Excess Power Flow to BC Hydro’ for the remedy on the cascading outage event.

Note 3: Keep at least 4 KMO unit online post-contingency shedding. Minimum generator units online are given priority over generator shedding at KMO.

Note 4: KMO Generation Shedding Arming Sequence: KMO G6 must be the first unit to be armed if its output is above 90 MW. This is to avoid negative impact on the transient stability because KMO G6 has the worst dynamic performance comparing with other KMO units. Both KMO G2 and G6 normally connect to KMO station services. KMO G2 is always kept online post generation shedding to supply station load. If KMO G2 is off line and generation shedding is required, G6 shall not be armed and its output needs be less than 90 MW.

### 12.2.7 Loss of L81-87 and L82-88

| System Condition | SHEDDING REQUIREMENTS |
|---|---|
| System Normal | If 2L103 MIN – L81-87_KIT – L82-88_KIT > 2L103_Over_Rating , then<br>• DTT KIT KMP potline load. |
| BQN 2CX1 OOS, or 2L102 OOS, or<br>KIT 2CX1 and 2CX2 OOS, or<br>KIT 2CX1 OOS, or KIT 2CX2 OOS, or<br>L81-87 OOS, or L82-88 OOS, or<br>L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS, or<br>SKA T1 OOS, or SKA T2 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | DTT KIT KMP potline load |
| 2L99 OOS | Consult Operations Planning for operational instructions |
| 2L103 OOS | RTA will be islanded on its own |

### 12.2.8 Loss of L81-87 or L82-88

**Table 12.2.8.1 – L81-87 and L82-88 Transmission Line Continuous Ratings**

| 287 kV Circuit | Variable Name Used in Generation Shedding Tables | Conductor Continuous Rating (Amp) | | Corresponding Continuous MW Rating (1.732 * Rating in kA * 287 kV) | |
|---|---|---|---|---|---|
| | | Apr 1 – Oct 31 (Based on 25 C ambient) | Nov 1 – Oct 31 (Based on 5 C ambient) | Apr 1 – Oct 31 (Based on 25 C ambient) | Nov 1 – Oct 31 (Based on 5 C ambient) |
| L81-87 | L81-87_Norm_Rating | 1359 | 1576 | 675 | 783 |
| L82-88 | L82-88_Norm_Rating | 1359 | 1576 | 675 | 783 |

**Table 12.2.8.2 – L81-87 and L82-88 Transmission Line Over Ratings**

| 287 kV Circuit | Variable Name Used in Generation Shedding Tables | Conductor Continuous Rating (Amp) | | Corresponding Continuous MW Rating (1.732 * Rating in kA * 287 kV) | |
|---|---|---|---|---|---|
| | | Apr 1 – Oct 31 (Based on 25 C ambient) | Nov 1 – Oct 31 (Based on 5 C ambient) | Apr 1 – Oct 31 (Based on 25 C ambient) | Nov 1 – Oct 31 (Based on 5 C ambient) |
| L81-87 | L81-87_Over_Rating | 1359 | 1576 | 675 | 783 |
| L82-88 | L82-88_Over_Rating | 1359 | 1576 | 675 | 783 |

Note: Since only continuous normal rating information is available, L81-87 and L82-88 Normal Ratings have been used for their Over Ratings.

**Table 12.2.8.3 – Generation Shedding Requirements for Loss of L81-87 or L82-88**

| System Condition | Contingency | KMO Online Units | SHEDDING REQUIREMENTS (Note 1,2,3, and 4) |
|---|---|---|---|
| System Normal, or<br>2L102 OOS, or<br>BQN 2RX231 OOS, or<br>BQN 2RX232 OOS | 87L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-88_Over_Rating MW<br>• 2.20 * (KMO_Gen – 0.25 * $L_{KIT}$ – 540) MW [transient stability] |
| | | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-88_Over_Rating MW<br>• 1.73 * (KMO_Gen – 0.27 * $L_{KIT}$ – 558) MW [transient stability] |
| | 88L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L81-87_Over_Rating MW |

| | | | |
|---|---|---|---|
| | | | • 2.20 * (KMO_Gen – 0.25 * $L_{KIT}$ – 540) MW [transient stability] |
| | | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L81-87_Over_Rating MW<br>• 1.73 * (KMO_Gen – 0.27 * $L_{KIT}$ – 558) MW [transient stability] |
| 87L OOS, or<br>87L and KIT 2CX1 OOS | 88L | 7 or 8 | DTT KIT KMP potline load |
| 88L OOS, or<br>88L and KIT 2CX2 OOS | 87L | 7 or 8 | DTT KIT KMP potline load |
| KIT 2CX1 and 2CX2 OOS | 87L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-88_Over_Rating MW<br>• 1.74 * (KMO_Gen – 0.23 * $L_{KIT}$ – 490) MW [transient stability] |
| | 87L | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L81-88_Over_Rating MW<br>• 1.51 * (KMO_Gen – 0.22 * $L_{KIT}$ – 545) MW [transient stability] |
| | 88L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-87_Over_Rating MW<br>• 1.74 * (KMO_Gen – 0.23 * $L_{KIT}$ – 490) MW [transient stability] |
| | 88L | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88L_KMO –87L_Over_Rating MW<br>• 1.51 * (KMO_Gen – 0.22 * $L_{KIT}$ – 545) MW [transient stability] |
| KIT 2CX1 OOS | 87L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L81-88_Over_Rating MW |

| | | | |
|---|---|---|---|
| | | | • 1.74 * (KMO_Gen – 0.23 * $L_{KIT}$ – 490) MW [transient stability] |
| | 87L | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L81-88_Over_Rating MW<br>• 1.51 * (KMO_Gen – 0.22 * $L_{KIT}$ – 545) MW [transient stability] |
| | 88L | 7 or 8 | Same as System Normal |
| KIT 2CX2 OOS | 87L | 7 or 8 | Same as System Normal |
| | 88L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-87_Over_Rating MW<br>• 1.74 * (KMO_Gen – 0.23 * LKIT – 490) MW [transient stability] |
| | 88L | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-87_Over_Rating MW<br>• 1.51 * (KMO_Gen – 0.22 * LKIT – 545) MW [transient stability] |
| BQN 2CX1 OOS, or<br>SKA T1 OOS, or<br>SKA T2 OOS | 87L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-88_Over_Rating MW<br>• 1.96 * (KMO_Gen – 0.29 * $L_{KIT}$ – 495) MW [transient stability] |
| | | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-88_Over_Rating MW<br>• 1.69 * (KMO_Gen – 0.31 * $L_{KIT}$ – 531) MW [transient stability] |

| | | | |
|---|---|---|---|
| | 88L | 7 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-87_Over_Rating MW<br>• 1.96 * (KMO_Gen – 0.29 * $L_{KIT}$ – 495) MW [transient stability] |
| | | 8 | Shed at KMO the greater of:<br>• L81-87_KMO + L82-88_KMO – L82-87_Over_Rating MW<br>• 1.69 * (KMO_Gen – 0.31 * $L_{KIT}$ – 531) MW [transient stability] |
| 2L99 OOS | 87L or 88L | Consult Operations Planning for operational instructions | |
| 2L103 OOS | | RTA is islanded with 2L103 OOS | |

Note 1: Number of Harmonics Filters at KIT has to be reduced accordingly when KIT load is reduced. This is to maintain KMO generator terminal voltage to be at least 0.95 p.u. in order to achieve acceptable transient performance and maintain post-contingency system voltage.

Note 2: KMO Generation Shedding Arming Sequence: KMO G6 must be the first unit to be armed if its output is above 90 MW. This is to avoid negative impact on the transient stability because KMO G6 has the worst dynamic performance comparing with other KMO units. Both KMO G2 and G6 normally connect to KMO station services. KMO G2 is always kept online post generation shedding to supply station load. If KMO G2 is offline and generation shedding is required, G6 shall not be armed and its output needs be less than 90 MW.

Note 3: When there are 7 KMO units available, keep at least 3 units online post-contingency. When there are 8 KMO units available, keep at least 4 units online post-contingency.

Note 4: Minimum Units On-line requirements are given priority over generation shedding for KMO.

### 12.2.9 Removed

### 12.2.10 Removed

### 12.2.11 2L100 or 2L107 or 2L100&2L107 Contingency

**Table 12.2.11.1 – Generation Shedding Requirements at KMO for Loss of 2L100 or 2L107 or both of 2L100&2L107**

| System Condition | KMO Online Units | SHEDDING REQUIREMENTS (Note 1,2,3, 4) | SHEDDING REQUIREMENTS at FKR/MCY/VOL |
|---|---|---|---|
| System Normal, or 2L102 OOS, or BQN 2RX231 OOS, or BQN 2RX232 OOS | 7 | Shed at KMO:<br>• 2.58 * (KMO_Gen – 0.47 * $L_{KIT}$ – 525) MW [transient stability] | Not required |
| | 8 | Shed at KMO:<br>• 2.34 * (KMO_Gen – 0.58 * $L_{KIT}$ – 515) MW [transient stability] | Not required |
| KIT 2CX1 and 2CX2 OOS, or SKA T1 OOS, or SKA T2 OOS | 7 | Shed at KMO:<br>• 3.00 * (KMO_Gen – 0.47 * $L_{KIT}$ – 506) MW [transient stability] | Not required |
| | 8 | Shed at KMO:<br>• 2.80 * (KMO_Gen – 0.56 * $L_{KIT}$ – 511) MW [transient stability] | Not required |
| BQN 2CX1 OOS | 7 | Shed at KMO<br>• 3.39 * (KMO_Gen – 0.46 * $L_{KIT}$ – 525) MW [transient stability] | Shed at FKR<br>• 1.62 * (2L102_BQN – 240) MW [transient stability]<br>Arm VOL, MCY first, then FKR |
| | 8 | Shed at KMO<br>• 3.07 * (KMO_Gen – 0.58 * $L_{KIT}$ – 515) MW [transient stability] | Shed at FKR<br>• 1.62 * (2L102_BQN – 240) MW [transient stability]<br>Arm VOL, MCY first, then FKR |

| | | | |
|---|---|---|---|
| KIT 2CX1 OOS or KIT 2CX2 OOS | 7 | Shed at KMO<br>• 2.42 * (KMO_Gen – 0.43 * $L_{KIT}$ – 532) MW [transient stability] | Not required |
| | 8 | Shed at KMO<br>• 2.16 * (KMO_Gen – 0.54 * $L_{KIT}$ – 523) MW [transient stability] | Not required |
| L81-87 and KIT 2CX1 OOS, or<br>L82-88 and KIT 2CX2 OOS | 7 | Shed at KMO:<br>• 3.45 * (KMO_Gen - 0.36 * $L_{KIT}$ – 523) [transient stability] MW | Not required |
| | 8 | Shed at KMO:<br>• 2.72 * (KMO_Gen - 0.33 * $L_{KIT}$ – 549) [transient stability] MW | Not required |
| L81-87 OOS, or<br>L82-88 OOS | 7 | Shed at KMO:<br>• 2.58 * (KMO_Gen - 0.36 * $L_{KIT}$ – 524) [transient stability] MW | Not required |
| | 8 | Shed at KMO:<br>• 1.81 * (KMO_Gen - 0.32 * $L_{KIT}$ – 550) [transient stability] MW | Not required |
| 2L99 OOS | | Consult Operations Planning for operational instructions | Not required |
| 2L103 OOS | | RTA is islanded with 2L103 OOS | Not required |

Note 1: Number of Harmonics Filters at KIT has to be reduced accordingly when KIT load is reduced. This is to maintain KMO generator terminal voltage to be at least 0.95 p.u. in order to achieve acceptable transient performance and maintain post-contingency system voltage.

Note 2: KMO Generation Shedding Arming Sequence: KMO G6 must be the first unit to be armed if its output is above 90 MW. This is to avoid negative impact on the transient stability because KMO G6 has the worst dynamic performance comparing with other KMO units. Both KMO G2 and G6 normally connect to KMO station services. KMO G2 is always kept online post generation shedding to supply station load. If KMO G2 is offline and generation shedding is required, G6 shall not be armed and its output needs be less than 90 MW.

Note 3: When there are 7 KMO units available, keep at least 3 units online post-contingency. When there are 8 KMO units available, keep at least 4 units online post-contingency.

Note 4: Minimum Units On-line requirements are given priority over generation shedding for KMO.

### 12.3 5L61 RAS

To optimize the North Coast system performance, 5L61 will be tripped for the simultaneous loss of 5L51 and 5L52, OR loss of 5L51 (or 5L52) with 5L52 (or 5L51) out of service when BCH balancing authority has high transfers from US to BC on Path 3 and when MW transfer on 5L61 from WSN is less than 75 MW. In this transfer range, total area generation inside the island Generation is close to the area load or greater, such that the load can be sustained on separation, minimizing impact to the region during the Path 3 Intertie separation event. See SOO 7T-18 for more detailed information on the RAS arming, and SOO 7T-64 for information on the rotational energy requirements resulting from the arming status of the RAS.

## 13.0 SEPARATION AND RESTORATION

This section provides information on the immediate separation and restoration actions for North Coast Operations. For operations under permanent faults on 5L61 (or 5L62, or 5L63), refer to Section 14 for North Coast Islanded Operations.

### 13.1 Loss of Kemano Generation Issues

Since BCH EMS has limited visibility to RTA's KMO substation, the RAS actions for "Loss of KMO north bus" and "Loss of KMO south bus" are not implemented in BCH TSAPM application (refer to Section 12.2.9 and Section 12.2.10 for details). In order to ensure the BCH North Coast transmission system will survive under such extreme contingencies, the following schemes have been implemented:

- At KIT, if KIT voltage is below 256 kV for more than 1.6 seconds, then trip RTA KIT potline load.
- At KIT, if the power flow from MIN to KIT exceeds 254 MW for 0.033 seconds and KIT voltage is below 256 kV, then trip RTA KIT potline load.

The potline trip signal (loss of KIT potline Load) from the above two schemes, shall be feedback to the KIT RAS controller as a potline shed RAS contingency to fulfill the generation shedding requirements for the loss of the KIT potline load.

### 13.2 Generation Load Imbalance

On the loss of 5L61, 5L62, 5L63 or 2L99, there may be a significant generation-load imbalance causing either low or high frequency impacts. This imbalance may be addressed through automatic actions, or require operator intervention to remedy.

#### 13.2.1 Under Frequency Impacts/Actions

Depending on the pre-outage loading, DTT 2L99/2L103 and/or direct load shedding at Red Chris Mine load, as well as automatic underfrequency load shedding will take place if the islanded area experiences under-frequency operation. Refer to Section 11.2 of this order for requirements of DTT 2L99/2L103 and/or direct load shedding at Red Chris Mine load. Refer to SOO 6T-28G underfrequency load shedding details.

Only A sustained frequency below 57.5 Hz will trip the RTA tie.

Prior to Potline pickup during islanded operation, the RTA Operator will

- Remove the harmonic filter from service on the first rectifier to be energized.

### 13.2.2 Over Frequency Impacts/Actions

Generation shedding requirements for loss of 2L99, 5L61, 5L62, or 5L63, or loss of the remaining SKA transformer (when one of SKA T1 or T2 is already OOS), may contribute to an over frequency condition immediately following separation. This may be due to prioritization of maintaining Minimum Units On-line over generation shedding (refer to Section 12.2.1, Section 12.2.3, and Section 12.2.4). The BCHCC Operator should immediately contact RTA Operator to reduce generation.

Normally KMO unit over frequency relay settings are all set to 63 Hz. When a North Coast Island is formed, One KMO unit should be selected by RTA Operator for tripping at 62 Hz.

## 13.3 Protection Initiated Separation

### 13.3.1 Excess Power Flow to BC Hydro

The 32LS protection relay at KIT has a power element set at 500 MW flow to BC Hydro, with a 0.133 second delay. If the RTA to BC Hydro transfer is above 500 MW for more than 0.133 s, then the relay will trip KIT potline load. The potline trip signal (loss of KIT potline Load) from the 32LS relay will feedback to the KIT RAS controller as a potline shed RAS contingency to fulfill the generation shedding requirements for the loss of the KIT potline load. This added protection function is designed to cover the sequential loss of KIT rectifier transformers which will result in loss of KIT potline load and cause excessive power flow to BC Hydro and power swings in the area. This is a temporary measure until the loss of KIT potline contingency covers this scenario. The detailed logic diagrams have been included in Attachment 2.

The MIN 2L103 PN has a power element set at 525 MW flow to BC Hydro, with a 0.5 second delay, that will send a transfer trip to KIT 2L103 PN. If the power flow is still detected after a further 0.15 second delay, then the MIN terminal will trip.

### 13.3.2 Out of Step Protection

The SKA terminal of 5L63 is equipped with an out-of-step relay that will detect a swing in either 5L63 or the SKA 500/287 kV transformers. The out-of-step relay trips (non-reclose) the SKA end of 2L99 circuit. This tripping separates RTA and MIN from the Integrated System.

The KIT terminal of 2L103 is equipped with out-of-step protection that will detect power swings between the KMO generators and the BCH system. The swings are centred in 2L99 circuit. The KIT out-of-step protection will trip the KIT end of 2L103 (non-reclose).

### 13.3.3 500 kV Overvoltage Protection

This protection is installed at SKA and if it operates it will trip the SKA end of 5L63 circuit, transfer trip to TKW and block autoreclosing of the circuit at SKA. The overvoltage relay trip settings are:

- 580 kV for at least 400 ms
- 625 kV for at least 50 ms

### 13.3.4 Undervoltage Protection

If the 287 kV bus voltage at KIT drops below 256 kV for more than 2 seconds, then 2L103 circuit will trip. The relay resets when voltage exceeds 263 kV.

### 13.4 Switching to Restore From Faults On 5L61, 5L62 or 5L63

For non-permanent faults, the preferred restoration method is:

- to energize from WSN 5L61 and pick up local load at GLN.
- to energize GLN 5L62 and pick up local load at TKW.
- to energize TKW 5L63 and re-synchronize with RTA generation.
- SKA and RUP loads can also be restored or to connect RPG generation as required.
- Follow the preferred method for energizing each line as in Section 6.0. Adding load as each line is energized will assist in controlling voltages before energizing the next line. The Northwest Area load can be as high as 300 MW but after an outage where load shedding has occurred it is expected to be half the pre-outage level on initial restoration.
- If the cause of a line outage was a 500 kV shunt reactor fault ensure considerations are met for energizing lines without reactors as covered in Section 6.0.
- Prior to putting through auto sync, the BCHCC Operator should work with the RTA System Operator to minimize the voltage difference and slip frequency across the open breaker. This will help minimize voltage and load swings during non-emergency synchronizing. The BCH auto synchronizers in the Northwest accept large voltage differences and slip frequencies to allow synchronizing under emergency circumstances. The delta V settings of SKA, TKW and GLN synchronizer are: SKA 60 kV, TKW 50 kV and GLN 40 kV.

### 13.5 Controlled Separation – SKA 2B11 Outage Requirement

When SKA 2B11 is out of service, the following action must be taken.
Either:

- Option 1: Open SKA 2CB7, to drop 2L102 under a SKA T2 contingency,

Or,

- Option 2: Offload SKA T4 in order to prevent 2L102 power flow through transformer under SKA T2 contingency. However, as a result of this contingency, 2L102 will be open ended at SKA and the line will need to be dropped as the IPP FKR is not designed to operate islanded.

## 14.0 NORTH COAST ISLANDED OPERATION

This section addresses requirements for maintaining and restoring loads within the island that is formed when one of 5L61, 5L62, or 5L63 trips and the separation is sustained. These scenarios are referred to as a “separation from the BCH system”, and “formation of a North Coast Island”.

- RTA has first priority for serving its own load with its generation, unless otherwise planned for (by mutual agreement). Surplus generation will be used to serve or restore BC Hydro load lost during planned and forced outages.
- If there is insufficient generation available to BC Hydro in the North Coast Island, BC Hydro will initiate load curtailments for capacity and energy emergencies. Transmission Voltage Customer (TVC) interruptible loads will be curtailed first. Distribution customer restoration will be prioritized over TVC loads.
- The procedures in this section utilize surplus generation resources in the North Coast Area. BC Hydro and IPP generation in the North Coast Island cannot operate to control frequency, and therefore must be increased or decreased with RTA providing frequency regulation.
- As IPP generation output is raised, RTA generation output can be backed off in preparation for block load pick ups.

As the RTA load is almost purely resistive, the load varies in direct proportional to voltage. Consequently, the frequency response of the islanded area to reactor switching is large.

For sustained separations of the North Coast area, the BCHCC Operator and the RTA Operator must coordinate operations to maintain a stable island. The following actions need to be taken:

- the SKA, TKW, and BQN AVC armings should be turned "OFF" as soon as possible by the BCHCC Operator (refer to LOO 3T-BQN-01).
- The BCHCC Operator must contact the RTA System Operator prior to initiating switching on the islanded system so RTA can adjust its frequency and voltage to compensate.
    - Switching in a reactor will bring down RTA voltage, thereby reducing their load and causing high frequency.
    - Switching in a line will increase voltage, thereby increasing their load and causing low frequency.
- When synchronizing, note that voltage settings of Northwest synchronizers have been set wide to facilitate restoration under extreme conditions.
- For outages that separate RTA from the BCH system of an hour or less, the BCHCC Operator will instruct the RTA System Operator to operate their tie-line controller in frequency control mode to regulate to 60 Hz.

- During a separation longer than one hour, the BCHCC Operator will instruct the RTA System Operator to increase the island frequency to 60.3 Hz and operate in tie-line frequency control mode to prevent load swings from causing inadvertent under frequency load shedding.

    - **Note:** No under frequency shedding will be blocked in BCH system.
    - **Note:** Refer to Section 13.3.1 and Section 13.3.2 for RTA's under frequency and over frequency settings.

- Operations of the island remain under the control of the BCHCC System Operator. Specifically, the BCH Transmission Coordinator (TC) will coordinate with the RTA System Operator, BCH Grid and Load Operators. The TC will:

    - request sectionalizations of any BCH Distribution or Transmission Voltage Customer (TVC) loads off line loads, by the BCH Grid and BCH Load Operators.
    - request RTA Operator to adjust the island frequency should be raised to 60.5 Hz prior to each instruction for load pick up by the BCH Grid and BCH Load Operators.
    - coordinate the actions of the BCH Grid Operator for the operation of IPP generation resources to support the islanded operation and advise the RTA System Operator of the expected changes in generation.
    - direct load block picks ups by the BCH Grid or Load Operators.
    - request the BCH Grid Operator to shed/restore interruptible loads as necessary to preserve the island.
    - coordinate the generation shedding/RAS requirements with the RTA Operator.

**Load Block Pick ups**: Load should not be added in greater than 25 MW blocks. One 25 MW block of load will drop the NW islanded system frequency by approximately 0.5 Hz. After each load pick up, the TC will allow the system to stabilize and address voltage support requirements prior to the next pick up. This is necessary to ensure the pick up does not cause underfrequency load shedding, the flow chart in Section 2 of Attachment 5 illustrates the iterative process for load pickups.

**Cold Load Pick up issues:** The Heavy Winter Base Case load of Smithers (SRS) and Hazelton Substations totals 50.7 MW. Prior to pickup of 1L385 at Telkwa, SRS feeder breakers should be opened to limit the cold load pickup of the station to less than 25 MW. In addition, SRS 1D22 should be opened to remove the Hazelton load. Subsequently the Hazelton load can be picked up via SRS 1D22. Cold Load pickup of Hazelton will probably not exceed 25 MW since a portion of the 10 MW industrial load would have to be restarted after a station outage. Since these stations are not equipped with remote control, they will have to be staffed for switching

**<u>Source for VDF</u>**: VDF can be fed from Beaverley Substation provided the load is less than 15 MW. Manual load shedding may be required to reduce the VDF and IPR loads. The winter peak load for VDF is 22 MW.

**<u>Use of the GLN - TKW 138 kV Tie</u>:** For outages to 5L62 circuit and insufficient generation in the North Coast area, the TKW 138 kV load can be fed from GLN via 1L384 / 1L398 / 1L396 circuits. Refer to SOO 5T-78 for further details.

## 14.1 Manual Load Shedding

Manual Load Shedding may be required in order to preserve the islanded network and provide capacity to serve essential loads. The intent of the restoration is to provide all customers with service for essential heat and light. It may be necessary then to shed no essential loads.

### 14.1.1 Transmission Voltage Customers

SOO 6T-29 Appendix 3 describes manual load shedding priorities for the NC Transmission Area. For the case of a 5L61 (or 5L62 or 5L63) permanent fault, the underfrequency load shedding scheme will shed at least some of the transmission voltage customers (refer to SOO 6T-28G). For some of these customers, their source breaker will open. They will subsequently call the BC Hydro Control Centre to request permission to close their breaker and restart their process. Transmission Voltage Customers should not be allowed to restart their industrial process. The intent of the restoration is to provide all these customers with service for essential heat and light however, see Attachment 5 for a list of TVC loads and an estimate of their essential loads.

### 14.1.2 25 kV Load Shedding

If the NC Transmission area load approaches the Heavy Winter Base Case, distribution load may have to be shed. For example, with the transmission voltage customers at minimum load (essential service) the NW load could peak at about 240 MW. The NC generation maximum capability may leave a shortfall of generation (see Section 3 of Attachment 5). Shedding can best be achieved by requesting 25/12 kV industrial customers to reduce load to essential services only. This will achieve about a 29 MW reduction. Section 4 of Attachment 5 lists 25 kV industrial customers whose load exceeds 1.0 MW, for load shedding consideration.

To proceed with 25 kV industrial load shedding, the BC Hydro Control Centre will request Key Account Management to contact the customers and request their load be reduced to essential service.

Additional 25/12 kV load shedding could be achieved by shedding feeders or possibly entire substations. If it is necessary to shed entire feeders or substations, a plan for rotating service between feeder/substations should be made.

## 14.2 RTA Setting Changes for Islanded Operation

(1) RTA's Generation Control Function
RTA needs to change to frequency control mode.

(2) Frequency Setting
The KMO governors are normally run in 5% speed droop. This setting is also used for automatic frequency control for the islanded system. The frequency set point can be manually adjusted at KMO. The frequency set point will normally be at 60.3 Hz. Prior to load pickup, the frequency will be raised to 60.5 Hz to lessen the risk of triggering underfrequency load sheds when additional load is added.

(3) Voltage Requirements
For the islanded system, voltage control of the 500 kV buses will follow SOO 7T-30 Section 4.0 - Voltage Control (note that for an islanded system the frequency will rise when reactive load is added).

(4) KMO Generator Shedding
The RTA and BCHCC Operators will consult to determine any generation shedding manual arming requirements for some local contingencies. The BCHCC operator will manually arm the contingencies in the BCH EMS (TSA-PM). The contingencies may include:
- Loss of 5L62
- Loss of 5L61
- Loss of 2L99
- Loss of 2L103
- Loss of 2L102

(5) Minimum Units On Line Post Contingency
To protect against next contingency impacts, RTA is requested to have the 2 unarmed units approximately matched with RTA load (KIT_aux + KMO_aux + margin). This is an operating guideline to aid in the recovery of the plant, in order to prevent black out and black start. It is recommended to use margin of 30 MW. Operations simulation studies show this margin level should not inadvertently trip units when Over Frequency relays are set at 62 Hz (see Section 13.2.2).

## 14.3 Rio Tinto VAR Loading in NC Transmission System Islanded Operation

The VAR loading of the islanded system, for various benchmark loads, is shown in Attachment 5 Section 3 Table 1 and Table 2. The table should help anticipate VAR load prior to line pickup and/or load pickup and determining if VAR load will encroach on the KMO (Kemano) generator capability.
- The tables do not show each stage of load pickup. They are intended only as a benchmark reference.
- The tables assume that 500 kV line reactors are energized with the lines. Benchmark stages are shown with and without SKA 12RX1, SKA 12RX2, TKW 12RX2 and TKW 12RX3 energized. Power flow and VAR for 2L103 tie line is also shown for each benchmark stage.

## 14.4 Prince Rupert Area Islanding

The BCHCC Operators should assess the capabilities of the Prince Rupert area generation and availability of supply for separation events longer than 12 hours. If there is sufficient generation, then the Prince Rupert area can be further separated in to a small island, to provide greater load security for port operations (refer to SOO 6T-73).

## 15.0 TSA-PM IMPLEMENTATION

The 2L103 transfer limits shown in Sections 9.0 and 10.0 have been implemented in EMS TSA-PM. If TSA-PM fails to calculate a transfer limit due to a no-match condition, such as for an unstudied condition or operating case, then 2L103 flow should be reduced as appropriate (see Sections 9.0 and 10.0). For example, with one of the KMO-KIT circuits and 5L61 OOS, TSA-PM will issue an AOR AG alarm, and operator action to assess and reduce flows should be initiated.

When a limit cannot be determined by TSA-PM, or by Operators' assessment, TDSO Operations Planning should be contacted to study the condition and advice for an appropriate transfer limit.

## 16.0 ALARMS

The following alarms are implemented in TSA-PM.

| ALARM MESSAGE | REFERENCES |
|---|---|
| (7T30) RTA TO BCH IMPORT SETPOINT LIMIT VIOLATION | General Alarm for control room action |
| (7T30) RTA ICCP OOS - USE MIN 2L103 ANALOG ALARMS | |
| (7T30) BCH EXPORT TO RTA LIMIT EXCEDENCE | Section 9.0 |
| (7T30) CONSULT OPS PLANNING: BCH TO RTA TRANSFER | Section 9.1 |
| (7T30) KIT POWER FACTOR MUST BE 0.98 TO 1.0 LAGGING | Section 10.0 |
| (7T30) BCH IMPORT FROM RTA LIMIT VIOLATION | Section 10 |
| | |
| | |
| (7T30) CONSULT OPS PLANNING: F2L103_KIT <= 0MW | Section 11.2 |
| (7T30) MUST NOT OPERATE IN THIS CONDITION | Section 11.3 |
| | Section 11.3, Section 11.4,<br>Section 11.5 |
| (7T30) FKR/VOL/MCY MIN MVA VIOLATION | |
| (7T30) CONSULT OPS PLANNING: ALL FKR/MCY/VOL UNIT OOS | |
| (7T30) CONSULT OPS PLANNING: RMR REQ FOR 2L99/103 CTG | |
| (7T30) CONSULT OPS PLANNING: RMR REQ W/ 2L99/103 OOS | |
| (7T30) CONSULT OPS PLANNING: SYSTEM COND. NOT COVERED<br>(7T30) VIOLATION 2L103 THER RATING | Section 11.6 |
| (7T30) CONSULT OPS PLANNING: 5L61/62/63 OOS | Section 11.7 |
| | General Alarms |
| (7T30) CONSULT OPS PLANNING | |
| (7T30) CXXX - CONSULT OPS PLANNING | |
| (7T30) CXXX - INSUFFICIENT SHEDDING AT KMO | |
| (7T30) CXXX - INSUFFICIENT SHEDDING AT FKR/VOL/MCY | |
| | |
| (7T30) CXXX-INSUFFICIENT SHEDDING | Section 12 |
| (7T30) CXXX-MIN UNIT ONLINE VIOLATION | Section 12 |
| (7T30) KMO GEN TERM VOLT < 0.95 PU. REDUCE # OF HARMONIC FILTERS AT KIT | Section 12.2.1 (Note 5) |
| (7T30) CXXX-KMO G6>90MW, ARM KMO G6 | Section 12.2.1 (Note 6) |
| (7T30) CXXX-KMO G2 OOS, REDUCE KMO G6 < 90MW | Section 12.2.1 (Note 6) |
| (7T30) CXXX-BQN 2RX22 MUST BE SWITCHED IN SERVICE | Section 12.2.1 (Note 8) |
| (7T30) CSKA_TX-OVERSHEDDING: SHED MUST BE < 5L63 SKA | Section 12.2.1 (Note 4) |
| (7T30) C5L61-OVERSHEDDING: SHEDDING MUST BE < 5L61 GLN | Section 12.2.4 (Note 4) |
| (7T30) C5L62-OVERSHEDDING: SHEDDING MUST BE < 5L62 TKW | Section 12.2.4 (Note 4) |
| (7T30) C5L63-OVERSHEDDING: SHEDDING MUST BE < 5L63 SKA | Section 12.2.4 (Note 4) |
| (7T30) C2L99-OVERSHEDDING: SHED MUST BE < 2L99 MIN+10MW | Section 12.2.3.2 (Note 2) |
| (7T30) CONSULT OPS PLANNING FOR GENSHED REQ | Section 12 |
| (7T30) C5LXX - TKW 12RX2 OR 12RX3 REQUIRED | Section 12.2.4 |
| | Section 9.0, Section 10.0 |

| | |
|---|---|
| (7T30) CONSULT OPS PLANNING FOR TRANSFER LIMIT | |
| | |
| (7T30) NO RTA TO BCH TRANSFER LIMIT AVAILABLE | |
| (7T30) EXPORT LIMIT NOT AVAILABLE | |
| | |

## 17.0 REVISION HISTORY

| Revised by | Revision Date | Summary of Revision |
|---|---|---|
| Amy Lam, Lili Bu, Bob Cielen | 12 May 2021 | • Section 1 revised for references<br>• Section 2 revised for responsibilities for Islanded operations<br>• Section 4.5 is revised with RPG self excitation risk information, formerly in Section 16<br>• Section 4.6 is revised with information for operation without 500 kV reactors previously in Section 8<br>• Section 5 is replaced with Protection and Auto-Reclosing, previously in Section 14<br>• Section 5.5 is added, with the content previously in Section 18 for 1L387 expanded tripping zone.<br>• Section 8 is replaced with synchronizing facilities, previously Section 15<br>• 5L61 RAS moved from previous Section 5.1 to new Section 12.3<br>• Section 11.5 is revised with recommendation for RTA keeping two KMO units in post-contingency of loss of potline load<br>• Section 11.7 is revised with recommendation for keeping two KMO units in post-contingency of loss of potline load<br>• Section 14 replaced with “North Coast Islanded Operation” (previously Section 5), and expanded to include content (with updates) previously in SOO 6T-71. Major update also includes information on the responsibilities and coordination actions for operations within the island.<br>• Attachment 5 (new) - adds content formerly in 6T-71 appendices with updated load values.<br>• Sections renumbered after Section 14. |
| Jun Lu | 30 June 2021 | • Section 10.0 – updated RTA to BCH transfer limits in Table 10.1<br>• Section 12.1.2 - added the second note about VOL shedding requirements.<br>• Section 12.2 – updated the generation shedding requirements at KMO/FKR/MCY/VOL.<br>• Section 16.0 – alarm list has been updated. |

| Revised by | Revision Date | Summary of Revision |
|---|---|---|
| Po Hu | 25 October 2021 | • Updated KIT load net power factor requirement in Section 10;<br>• Increased RTA to BCH Transfer Limit for system normal with 6 KMO units in operation from 0 to 280 MW in Section 10, Table 10.1;<br>• 2L103 transfer limit from RTA is updated for BQN 2CX1 OOS in Table 10.1;<br>• System condition with BQN 2CX1 OOS is removed from Table 12.2.1.3;<br>• New Table 12.2.1.5 – KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of 2L101 with BQN 2CX1 OOS is added;<br>• New Table 12.2.1.6 – KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of SKA T1 or SKA T2 with BQN 2CX1 OOS is added;<br>• Added a new table: Table 12.2.1.7 – KMO/FKR/VOL/MCY Generation Shedding Requirements for Loss of 2L101 or SKA T1 or SKA T2 with 6 KMO units in operation;<br>• Updated variable name KIT load to $L_{KIT}$ in Tables 12.2.1.5 to 12.2.1.7 in order to be consistent to other tables.<br>• Gen-shedding rule for 2L102 (1P) Contingency with BQN 2CX1 in Table 12.2.2 is updated;<br>• Gen-shedding rule for 2L99 Contingency with BQN 2CX1 in Table 12.2.3.1 is updated. |
| Po Hu/<br>Lili Bu | 05 July 2022 | • 6T-78 has been revised to 5T-78 throughout the document<br>• Updated BCH to RTA transfer limit on 2L103 at MIN in Section 9.1 using new 2L103 ratings;<br>• Updated RTA to BCH Transfer Limit in Section 10.0 using new 2L103 ratings;<br>• Removed a paragraph regarding 2L99 rating as a limiting factor in Section 11.1;<br>• Replaced 2L99 ratings with 2L103 ratings in Sections 11.6, 12.2.6, 12.2.7, and 16.0;<br>• Section 12.2.9 and Section 12.2.10 are removed as these are not implemented by BCH or RTA.<br>• Added 2L103 continuous and over ratings in Attachment 1;<br>• Removed 2L99 ratings in Attachment 1 |

| Revised by | Revision Date | Summary of Revision |
|---|---|---|
| Po Hu | 05 October 2022 | • Updated 2L103 transfer limits for various N-1 system conditions in Section 10.0 Table 10.1 and removed Note 4 for this table;<br>• Updated Generation Shedding (GS) requirements for 2L101 or SKA T1 or SKA T2 Contingencies in Tables: 12.2.1.1 – 12.2.1.3, 12.2.1.5 – 12.2.1.7 in Section 12.2.1;<br>• Added GS requirements in Tables: 12.2.1.8 – 12.2.1.10 for 2L101 or SKA T1 or SKA T2 Contingencies in Section 12.2.1;<br>• Updated GS requirements for 2L102 (1P) Contingency in Table 12.2.2 in Section 12.2.2;<br>• Updated GS requirements for 2L99 Contingency in Table 12.2.3.1 in Section 12.2.3;<br>• Updated GS requirements for loss of Kitimat Potline Load in Section 12.2.6;<br>• Updated GS requirements for Loss of L81-87 or L82-88 in Table 12.2.8.3 in Section 12.2.8;<br>• Added a new Section 12.2.11 to present GS requirements in Tables: 12.2.11.1 for 2L100 or 2L107 Contingency;<br>• Updated Attachment 3 – North Coast RAS Scheme Implementation to add new contingency signals: 2L107 and 2L100&2L107.<br>• Added 2L100 or 2L107 or 2L100&2L107 contingency in Section 11.7.<br>• Specified KMO G6 is the first unit to be tripped under some conditions in Section 12.1.3. |
| Po Hu | 22 November 2022 | • The KMO G6 power output threshold to arm G6 first is increased from 80 MW to 90 MW in Sections 12.1.3, 12.2.1, 12.2.6, 12.2.8, 12.2.11 and 16.0. |

| Revised by | Revision Date | Summary of Revision |
|---|---|---|
| Po Hu | 14 March 2023 | Capacities at KMO have increased with their Tunnel 2 commissioning. This update separates some of the KMO and FKR shedding requirements, with these new unit capacities.<br>• Updated unit details and information regarding KMO plant in Section 3.1;<br>• Updated Table 12.2.1.1 to present generation shedding requirements for Loss of SKA T1 or SKA T2 under Various System Conditions including System Normal;<br>• Updated Table 12.2.1.2 to show generation shedding requirements for Loss of 2L101 under Various System Conditions including System Normal;<br>• Removed Tables 12.2.1.3,12.2.1.5, 12.2.1.6, 12.2.1.8, 12.2.1.9;<br>• Updated Table 12.2.2– FKR/VOL/MCY Generation Shedding Requirements for 2L102 (1P) Faults;<br>• Updated Table 12.2.3.1 – FKR/VOL/MCY Generation Shedding Requirements for 2L99 Contingency;<br>• Updated Table 12.2.5 – FKR/VOL/MCY Generation Shedding Requirements for Single Phase Fault on 500 kV Transmission Lines;<br>• Updated generation shedding requirements table in Section 12.2.6 for Loss of Kitimat Potline Load;<br>• Updated Table 12.2.8.3 – Generation Shedding Requirements for Loss of L81-87 or L82-88;<br>• Updated Table 12.2.11.1 – Generation Shedding Requirements at KMO for Loss of 2L100 or 2L107 or both of 2L100&2L107; Removed Note 5 as the lines are now commissioned.<br>• Updated Table 12.2.1.10, 12.2.3.2, 12.2.4 to modify generation shedding requirements to control over frequency in NC islanding operation;<br>• Added two ambient temperature points, 20 ºC and 25 ºC, in 2L103 rating nomogram in Attachment 1. |

**Attachment 1 – 2L103 Thermal Ratings**

Table A1.1: 2L103 Continuous Rating

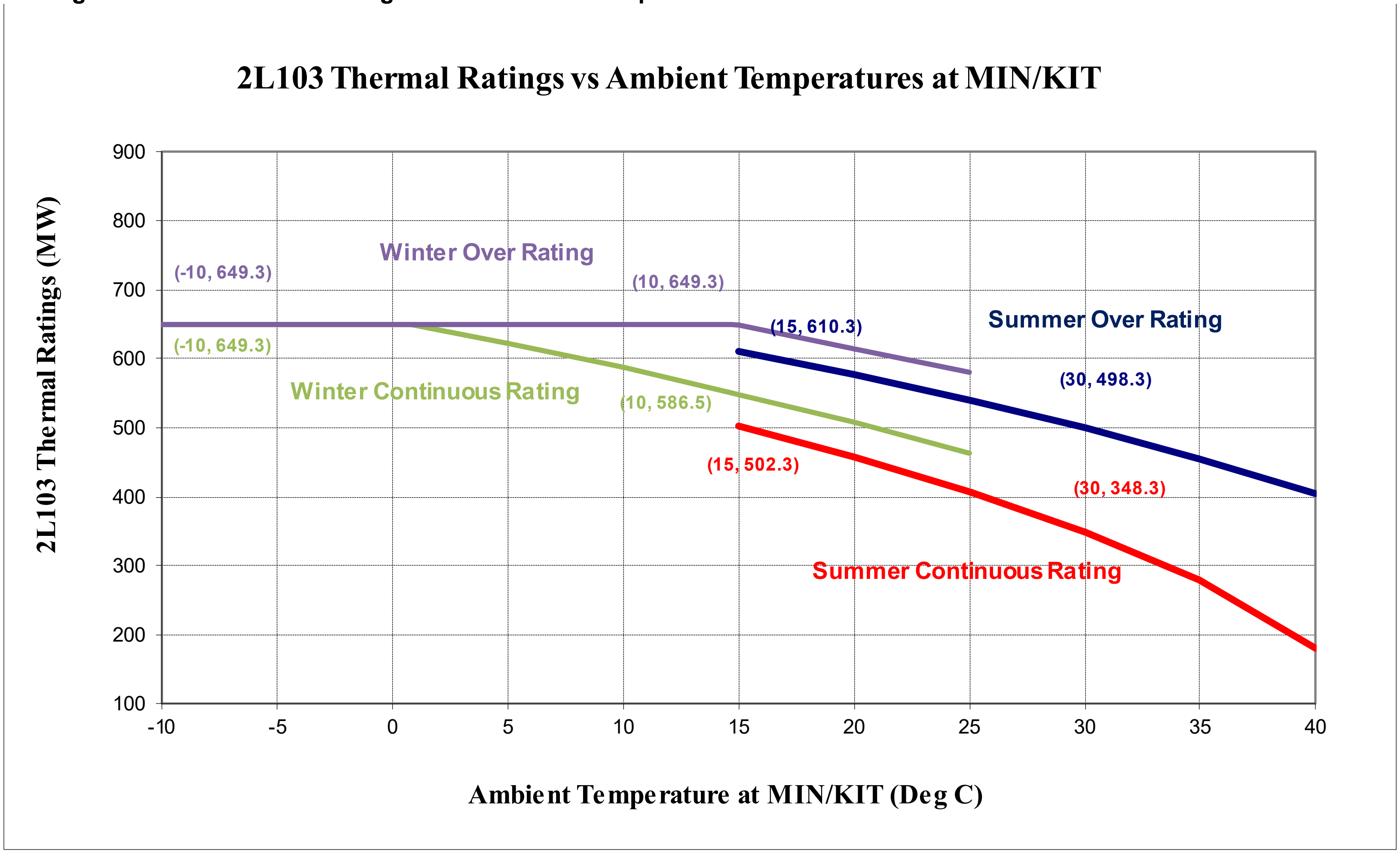
| Variable Name | 2L103 Norm Rating | | | |
|---|---|---|---|---|
| Ambient Temperature (Degree C) | Summer | | Winter | |
| | AMPS | MW (MW = 1.732 * Rating in KA * 287 kV * 0.98 pf) | AMPS | MW (MW = 1.732 * Rating in KA * 287 kV * 0.98 pf) |
| -10 ° | - | - | 1333 | 649.3 |
| -5 ° | - | - | 1333 | 649.3 |
| 0 ° | - | - | 1333 | 649.3 |
| 0.8 ° | - | - | 1333 | 649.3 |
| 5 ° | - | - | 1276 | 621.6 |
| 10 ° | - | - | 1204 | 586.5 |
| 15 ° | 1031 | 502.3 | 1126 | 548.5 |
| 20 ° | 938 | 457.0 | 1042 | 507.6 |
| 25 ° | 835 | 406.8 | 950 | 462.8 |
| 30 ° | 715 | 348.3 | - | - |
| 35 ° | 571 | 278.1 | - | - |
| 40 ° | 370 | 180.2 | - | - |

Table A1.2: 2L103 30 Minutes Emergency Rating

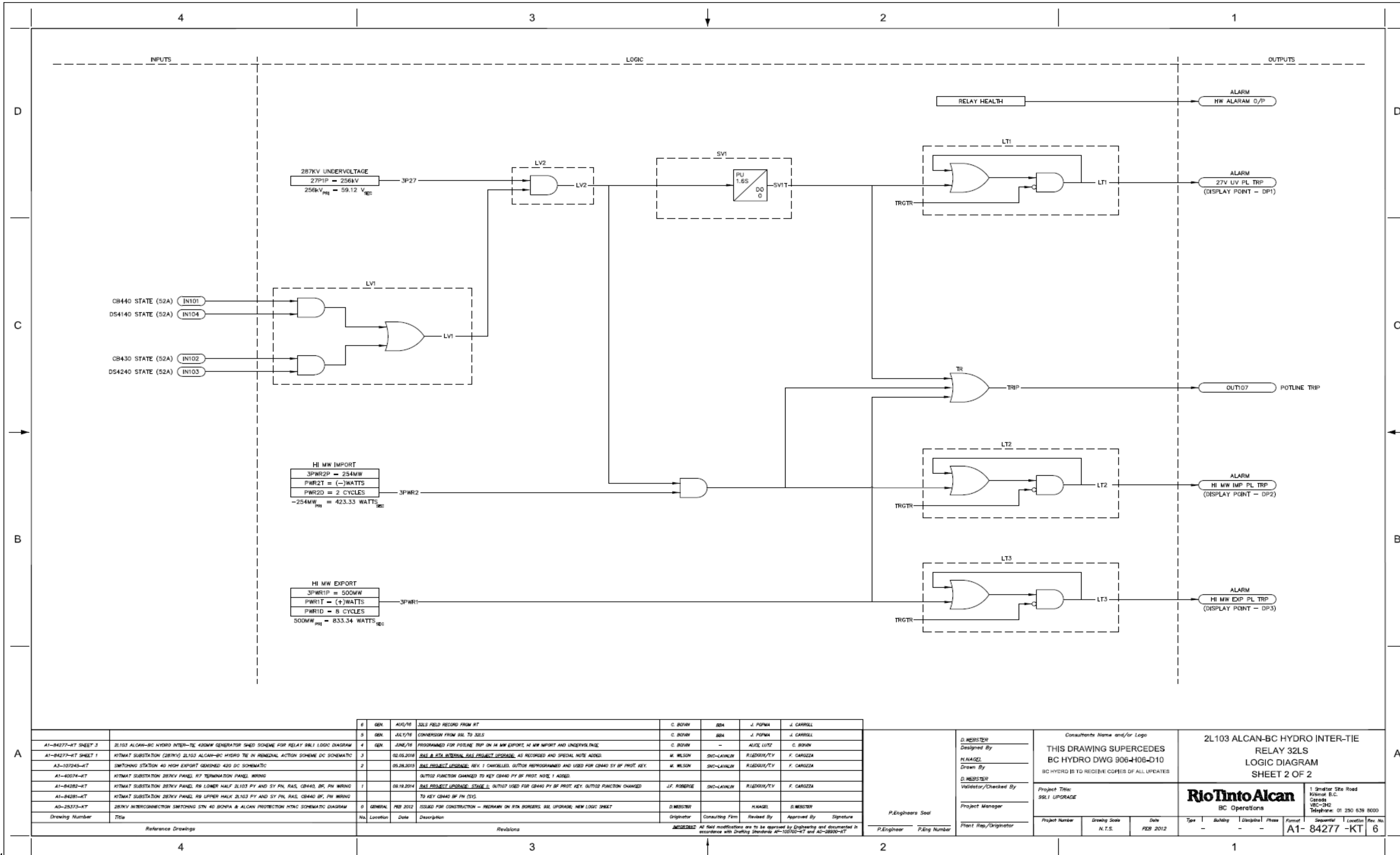
| Variable Name | 2L103_Over_Rating | | | |
|---|---|---|---|---|
| Ambient Temperature (Degree C) | Summer | | Winter | |
| | AMPS | MW (MW = 1.732 * Rating in KA * 287 kV * 0.98 pf) | AMPS | MW (MW = 1.732 * Rating in KA * 287 kV * 0.98 pf) |
| -10 ° | - | - | 1333 | 649.3 |
| -5 ° | - | - | 1333 | 649.3 |
| 0 ° | - | - | 1333 | 649.3 |
| 5 ° | - | - | 1333 | 649.3 |
| 10 ° | - | - | 1333 | 649.3 |
| 14.7 ° | - | - | 1333 | 649.3 |
| 15 ° | 1253 | 610.3 | 1329 | 647.4 |
| 20 ° | 1182 | 575.8 | 1262 | 614.8 |
| 25 ° | 1106 | 538.8 | 1191 | 580.2 |
| 30 ° | 1023 | 498.3 | - | - |
| 35 ° | 932 | 454.0 | - | - |
| 40 ° | 830 | 404.3 | - | - |

**Note 1**: Summer and winter periods in TSA-PM follow the definitions specified in SOO 5T-10 for the application of ratings that are in effect.
**Note 2 :** When calculating 2L103 thermal ratings, the higher temperatures at KIT or MIN shall be used.

**Nomogram – 2L103 Thermal Ratings versus Ambient Temperatures at KIT/MIN**



**Attachment 2 – KIT 32L Relay Logic Diagrams**




LAt

**Attachment 3 – North Coast RAS Scheme Implementation**

(See Notes following table)

| No. | Contingency | Gen-shedding at KMO (G1 to G8) | Generation Shedding Speed at KMO (within cycles) | Gen-shedding at FKR IPP (Groups 1-8) | Generation Shedding Speed at FKR (within cycles) | DTT KIT Potlineload | Speed for DTT at KIT Potlineload (within cycles) | DTT 2L103 at MIN end | Speed for DTT 2L103 at MIN end (within cycles) | DTT 2L99 at MIN end | Speed for DTT 2L99 at MIN end (within cycles) | Load Shed at Red Chris Mine | Speed for Load Shed at Red Chris Mine |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | L81-87 KMO-KIT (3P) | A | 8 | A | 11 | A | 8 | | | | | | |
| 2. | L82-88 KMO-KIT (3P) | A | 8 | A | 11 | A | 8 | | | | | | |
| 3. | L81-87 KMO-KIT (1P) | A | 8 | | | A | 10 (for fault at KIT), 11 (for fault at KMO) | | | | | | |
| 4. | L82-88 KMO-KIT (1P) | A | 8 | | | A | 10 (for fault at KIT), 11 (for fault at KMO) | | | | | | |
| 5. | L81-87 and L82-88 | | | | | A | 8 | | | | | | |
| 6. | 2L100 (from MIN) | A | 11 | A | 11 | | | | | | | | |
| 7. | 2L101 | | 11 | A | 11 | | | | | | | | |
| 8. | KMO North Bus fault | A | 11 | A | 11 | A | 8 | | | | | | |
| 9 | KMO South Bus fault | A | 11 | A | 11 | A | 8 | | | | | | |
| 10. | Loss of potline load | A | 8 | | | | | | | | | | |
| 11. | 5L61 WSN-GLN (3P) | A | 11 | A | 11 | | | A | 11 | A | 11 | A | 15 |
| 12. | 5L62 GLN-TKW (3P) | A | 11 | A | 11 | | | A | 11 | A | 11 | A | 15 |
| 13. | 5L63 TKW-SKA (3P) | A | 11 | A | 11 | | | A | 11 | A | 11 | A | 15 |
| 14. | SKA T1 | A | 9 | A | 9 | | | A | 11 | | | | |
| 15. | SKA T2 | A | 11 | A | 11 | | | A | 11 | | | | |
| 16. | 2L99 MIN-SKA | A | 11 | | | | | A | 11 | | | | |
| 17. | 5L61 WSN-GLN (1P) | | | A | 11 | | | | | | | | |
| 18. | 5L62 GLN-TKW (1P) | | | A | 11 | | | | | | | | |
| 19. | 5L63 TKW-SKA (1P) | | | A | 11 | | | | | | | | |
| 20. | 2L102 SKA-BQN (1P) | | | A | 11 | | | | | | | | |
| 21. | 2L107 (3P) | A | 11 | A | 11 | | | | | | | | |
| 22. | 2L100 and 2L107 (Note 5) | A | 11 | A | 11 | | | | | | | | |

Notes:

1) "A" denotes Availability of generation shedding facilities for the contingency.
2) The listed gen shed speed includes the time from the initiation of the disturbance to the completion of the required remedial action.
3) "1P" means single phase fault with successful reclose, and "3P" means three-phase fault.
4) The Gen-shed or DTT keying logic shall include line, bus or transformer protections, and breaker and disconnect statuses.
5) The double contingency signal shall cover both N-2 and N-1-1 contingencies.

**Attachment 4 – Underfrequency Load Shedding (UFLS) and DTT Requirements**

**General Notes for DTT Nomograms**

Note 1: DTT 2L103 or 2L99 shall be armed for loss of 5L61/5L62/5L63, if a system operating point determined by transfers on a corresponding North Coast region 500 kV line and L81-87/L82-88 is located in the red area in the following Diagrams. Similarly, Red Chris Mine load shedding shall be armed if a system operating point is located in the blue area. 5L61 WSN, 5L62 GLN, or 5L63 TKW could exceed 260 MW.

Note 2: The Nomogram (s) are/is only applicable when power transfer on 2L103 KIT is more than 0 MW. If power transfer on 2L103 KIT <= 0 MW, consult Operations Planning for operational instructions.

Note 3: For the condition of (L81-87 and KIT 2CX1 OOS), or (L82-88 and KIT 2CX2 OOS), or L81-87 OOS, or L82-88 OOS, the arming threshold of 670 MW transfer on the remaining line for summer season is determined by L81-87/L82-88's thermal rating which is provided in Kitimat Modernization Project: Kemano-Kitimat System Data Prepared for Use in BC Hydro Impact Study (Report No.: 25363-000-30R-J01-0001 Rev. 5.3).

Note 4: For the condition of (L81-87 and KIT 2CX1 OOS), or (L82-88 and KIT 2CX2 OOS), or L81-87 OOS, or L82-88 OOS, the arming threshold of 750 MW transfer on the remaining line for winter season is determined by a voltage stability limit.

Note 5: The DTT 2L99 and/or Red Chris Mine load shedding requirements for system condition of KIT 2CX1 and KIT 2CX2 OOS have been studied, and will also be applied for the system conditions of KIT 2CX1 OOS, or KIT 2CX2 OOS.

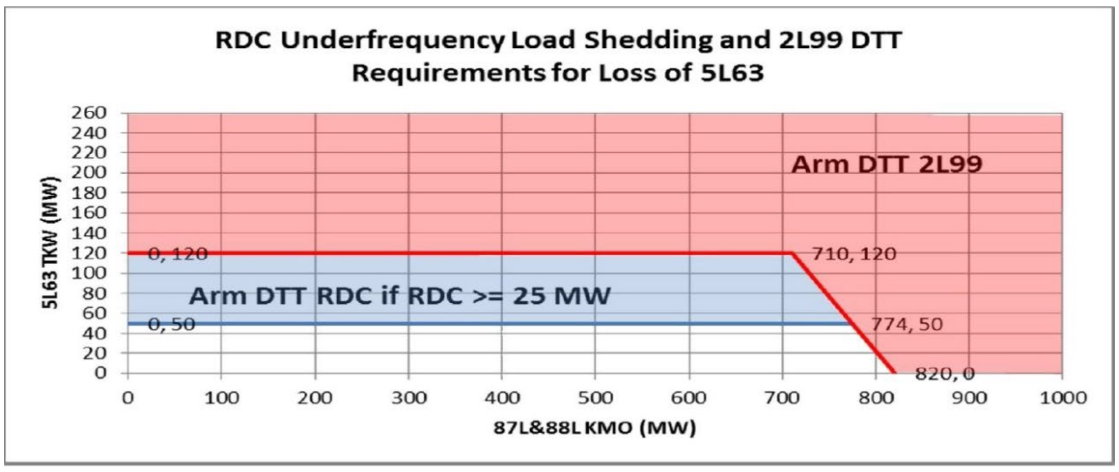
Note 6: The DTT 2L99 and/or Red Chris Mine load shedding requirements for system condition of L81-87 and KIT 2CX1 OOS, or L82-88 and KIT 2CX2 OOS have been studied, and will be applied for the system conditions of L81-87 OOS, or L82-88 OOS.

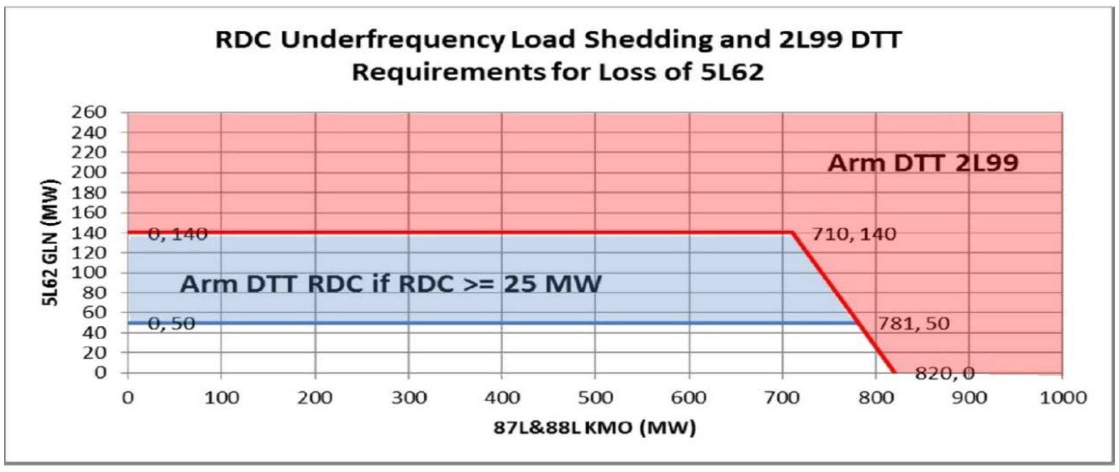
Note 7: DTT 2L99 shall be armed for loss of SKA T1 or T2 if the other SKA transformer is already out of service, resulting SKA area islanding from the main system, and a system operating point determined by transfers on 5L63 TKW and L81-87&L82-88 KMO is located in the red area in the following Diagrams. Similarly, Red Chris Mine load shedding shall be armed if a system operating point is located in the blue area.

## 1.0 KMO 7 Units Operation

**Diagram 1.1**
**System Conditions (Note 1, 2, 5 and 6):**

- System Normal, or;
- BQN 2CX1 or (KIT 2CX1 and 2CX2) or KIT 2CX1 or KIT 2CX2 or SKA T1 or SKA T2 or BQN 2RX232 or BQN 2RX231 OOS



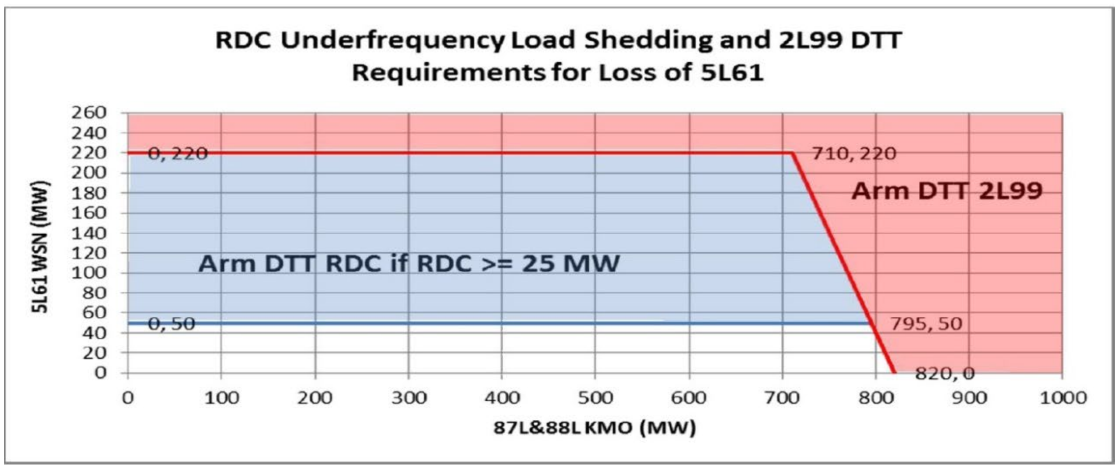
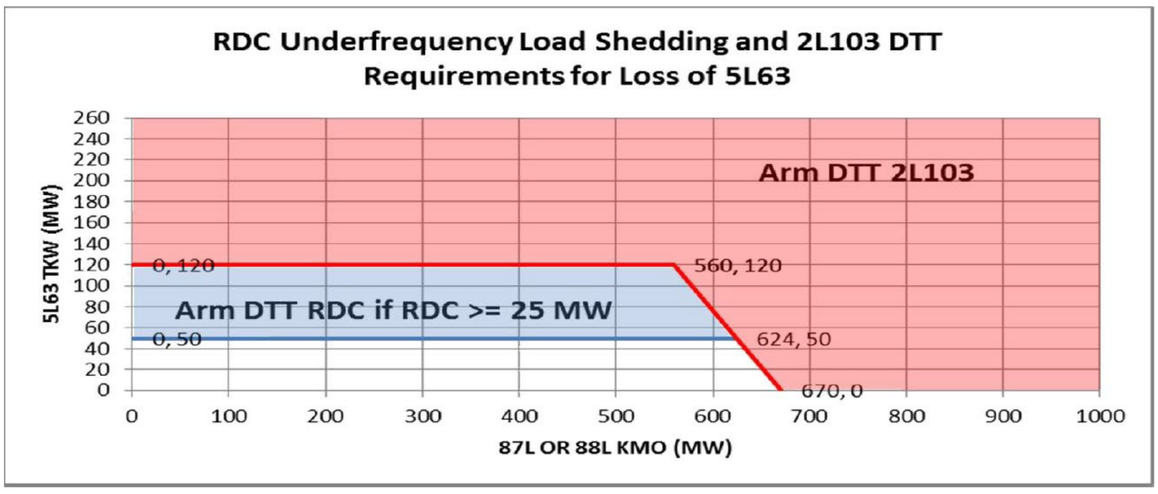
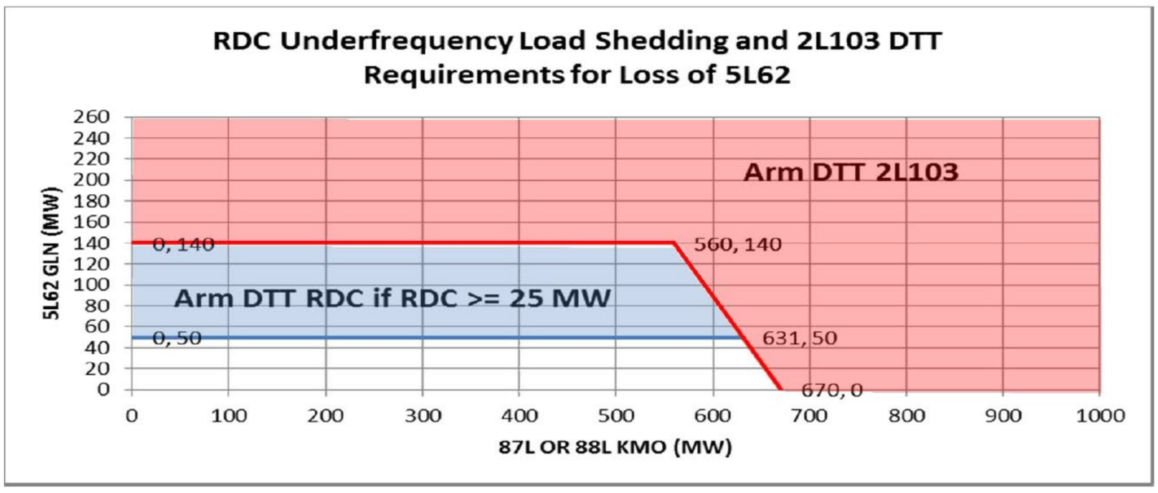



**Diagram 1.2**
**System Conditions (Note 1, 2, 5 and 6):**

- Summer Season (April 1st – Oct. 31st) and;
- (L81-87 and KIT 2CX1) or (L82-88 and KIT 2CX2) or L81-87 or L82-88 OOS



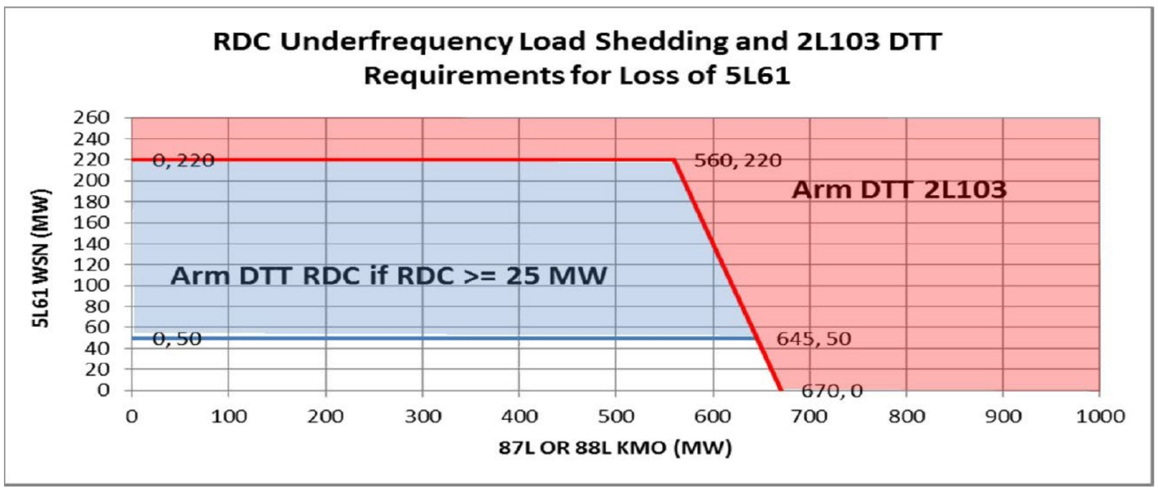
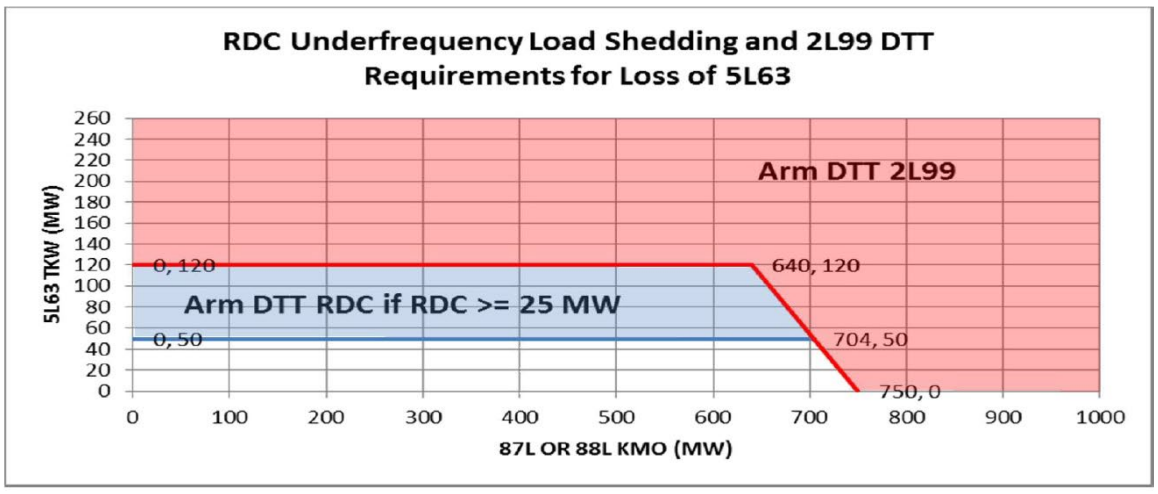
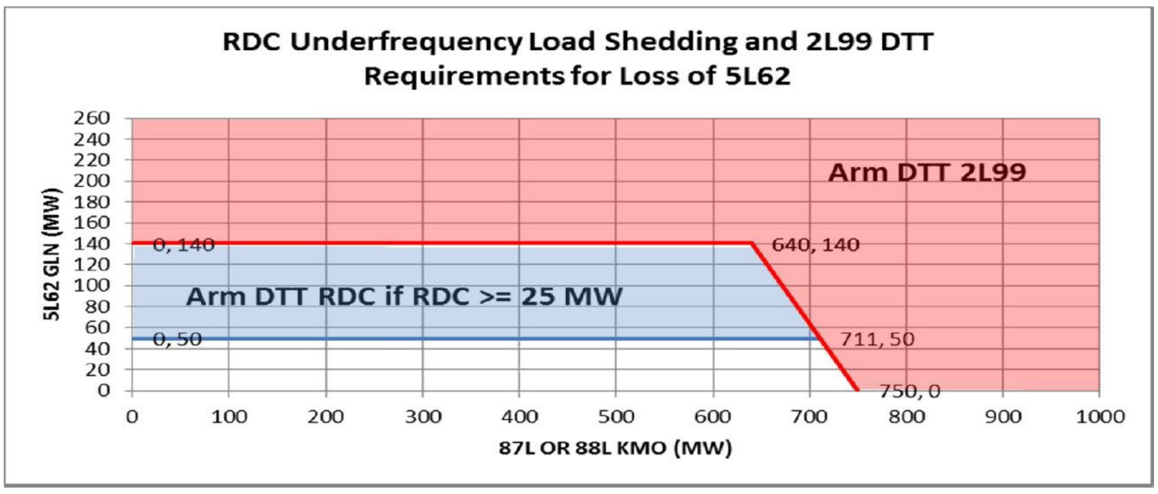



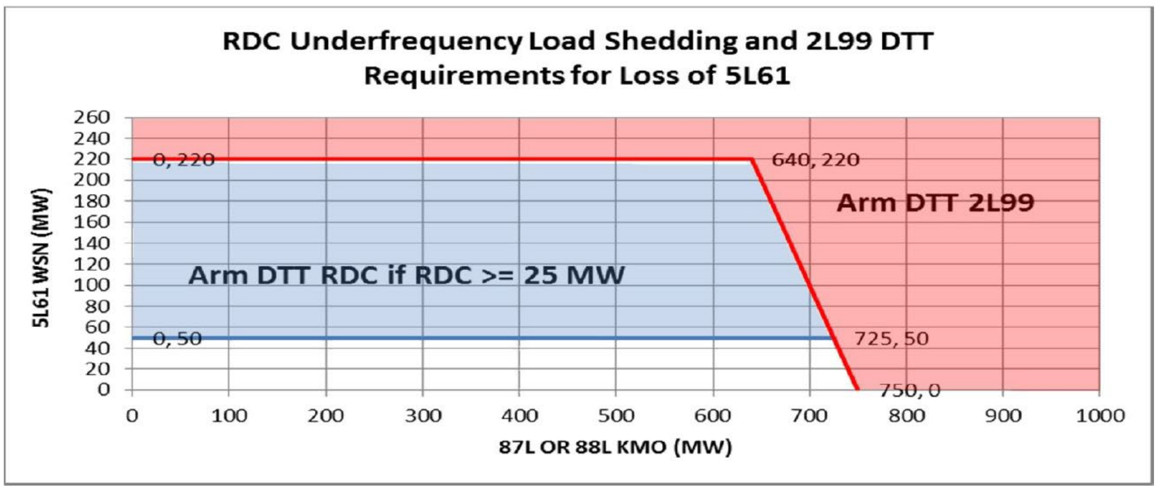
**Diagram 1.3**

**System Conditions (Note 1, 2 and 4):**

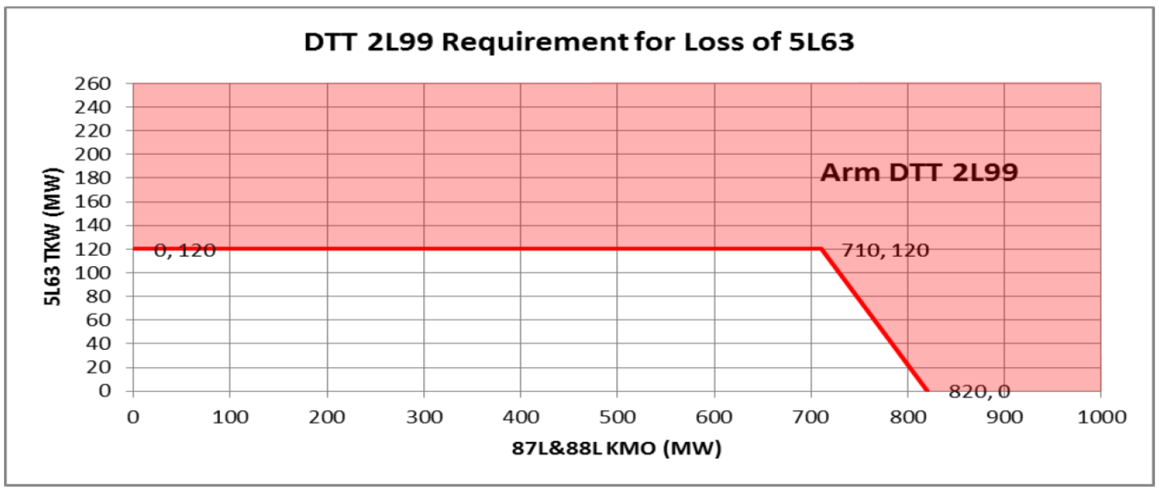
- Winter Season (Nov. 1st – Mar. 31st) and;
- (L81-87 and KIT 2CX1) or (L82-88 and KIT 2CX2) or L81-87 OOS, or L82-88 OOS

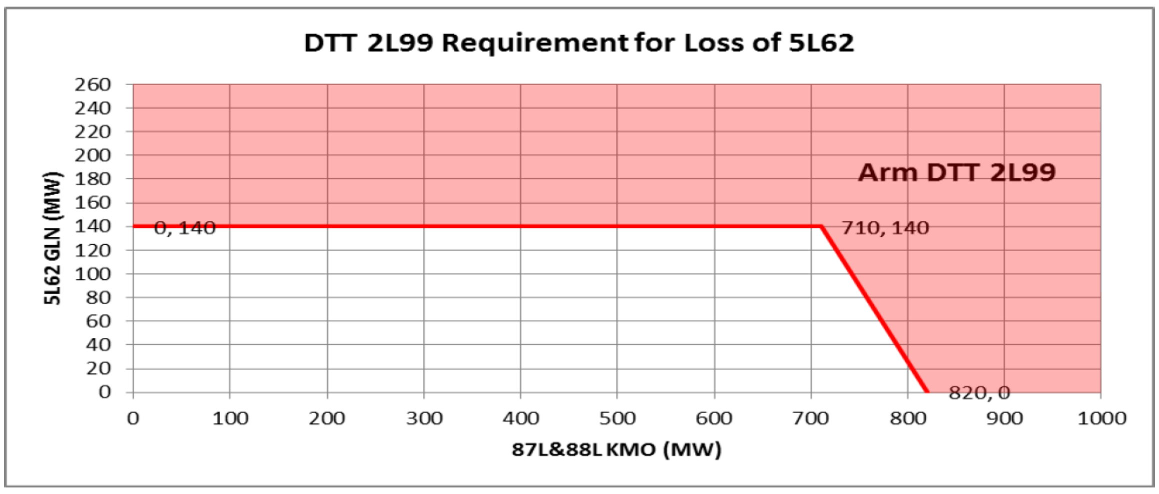


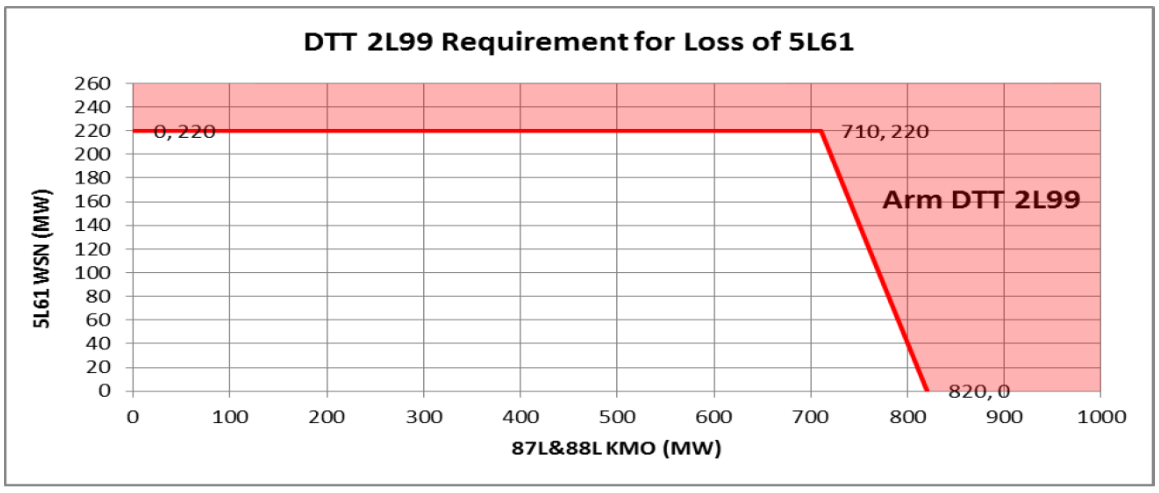



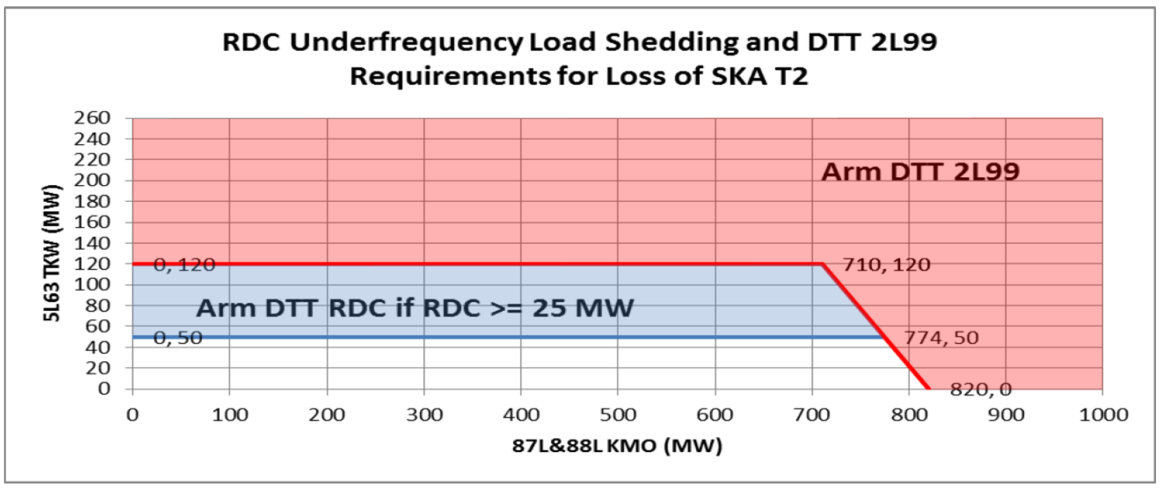
**<u>Diagram 1.4</u>**
**System Conditions (Note 1 and 2):**
- 2L102 OOS



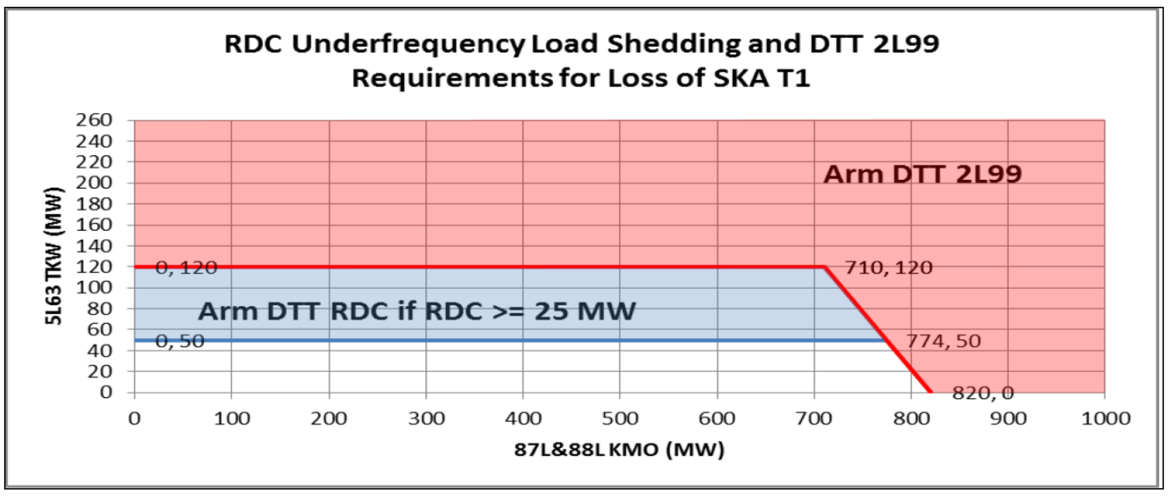



**<u>Diagram 1.5</u>**
**System Conditions (Note 2 and 7):**
- SKA T1 OOS



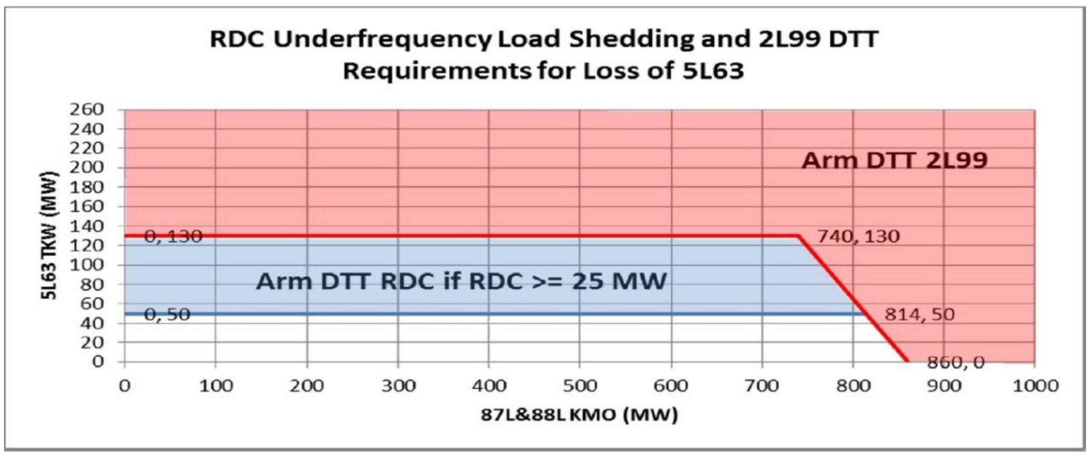

**<u>Diagram 1.6</u>**
**System Conditions (Note 2 and 7):**
- SKA T2 OOS

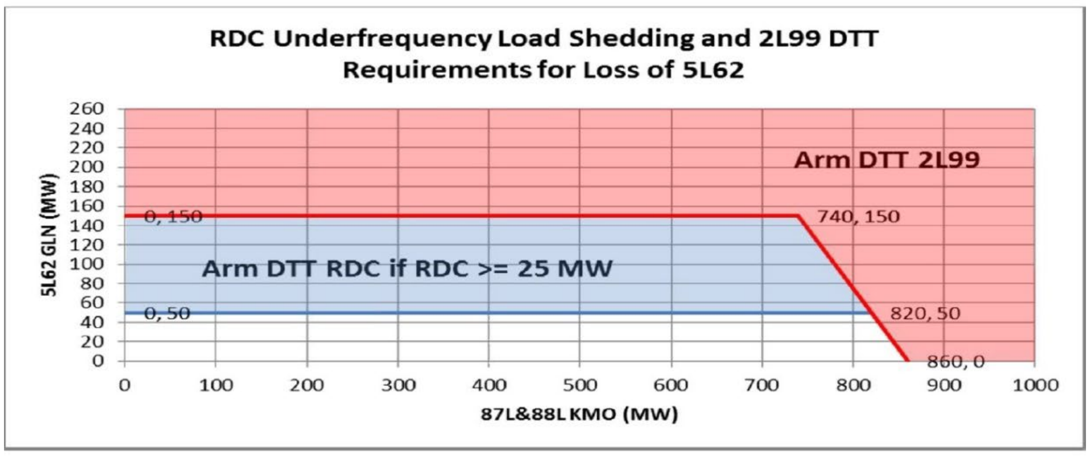


**2.0 KMO 8 Units Operation**

**Diagram 2.1**
**System Conditions (Notes 1, 2, 5 and 6):**

- System Normal, or;
- BQN 2CX1 or (KIT 2CX1 and 2CX2) or KIT 2CX1 or KIT 2CX2 or SKA T1 or SKA T2 or BQN 2RX232 or BQN 2RX231 OOS



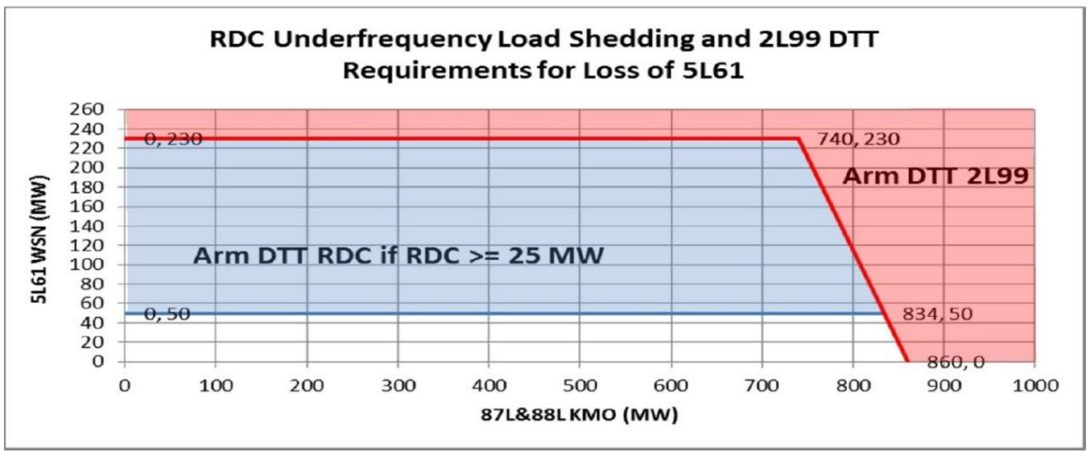
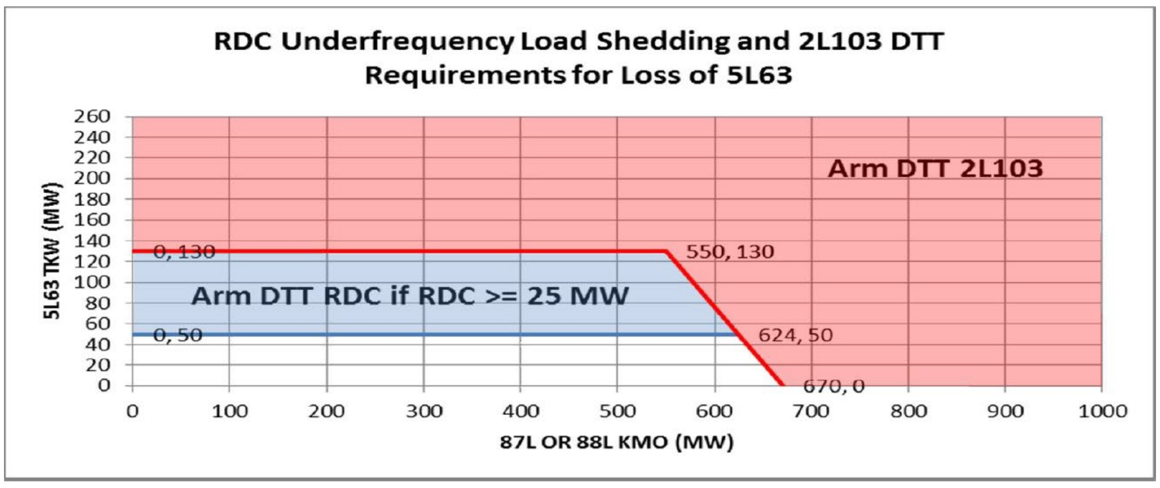
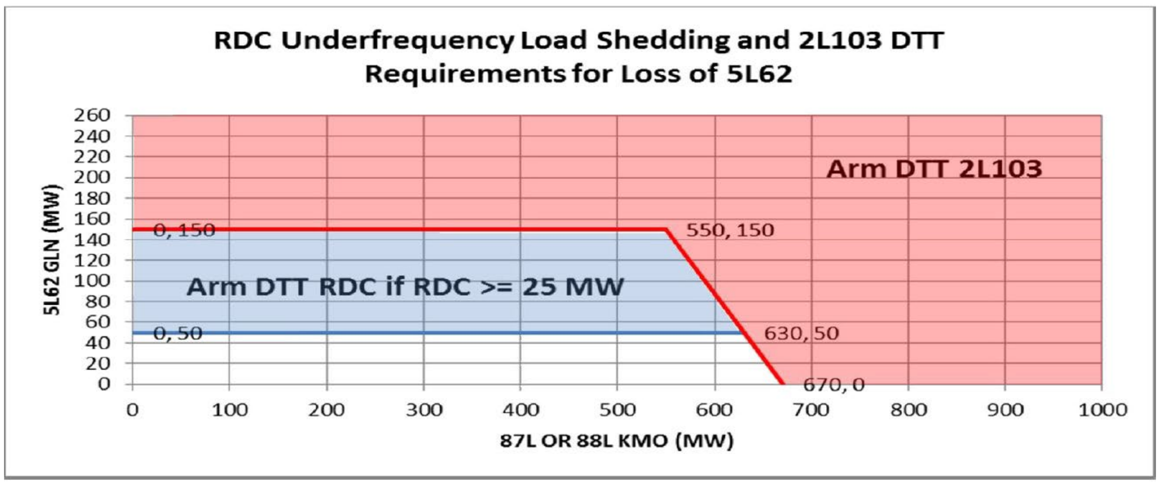



**Diagram 2.2**

**System Conditions (Notes 1, 2 and 3):**

- Summer Season (April 1st – Oct. 31st) and;
- (L81-87 and KIT 2CX1) or (L82-88 and KIT 2CX2) or L81-87 or L82-88 OOS



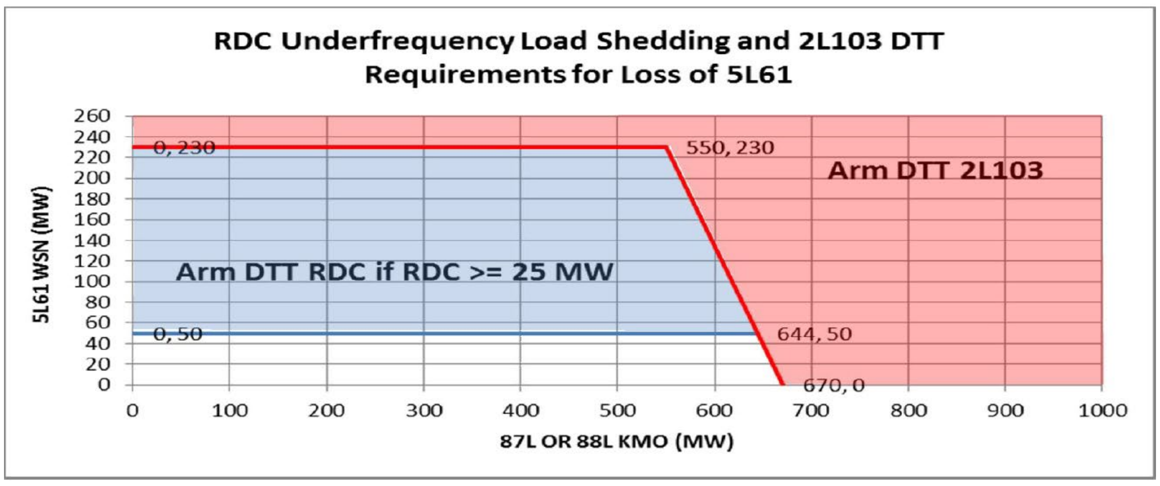
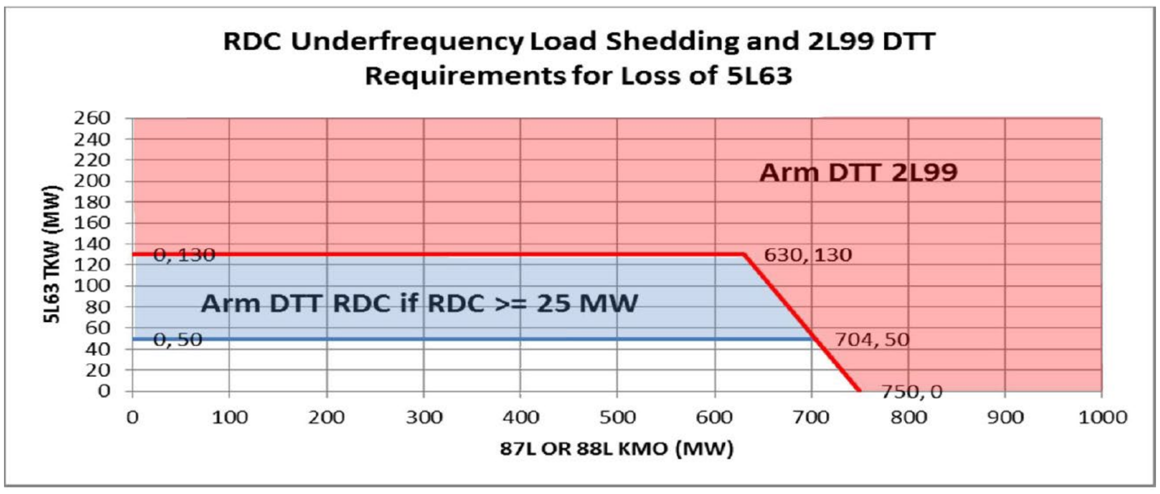
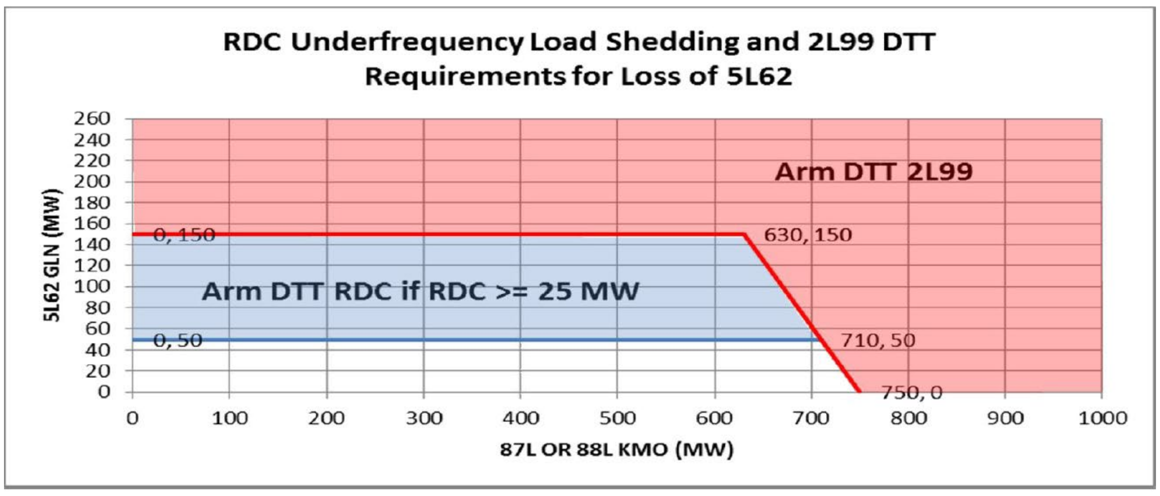



**Diagram 2.3**
**System Conditions (Notes 1, 2 and 4):**
- Winter Season (Nov. 1st – Mar. 31st) and;
- (L81-87 and KIT 2CX1) or (L82-88 and KIT 2CX2) or L81-87 OOS, or L82-88 OOS



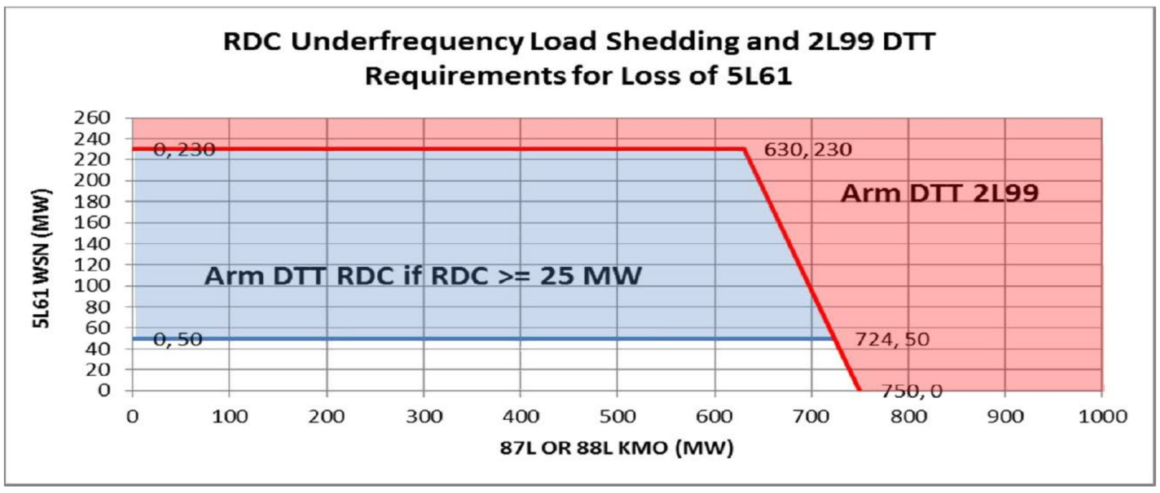
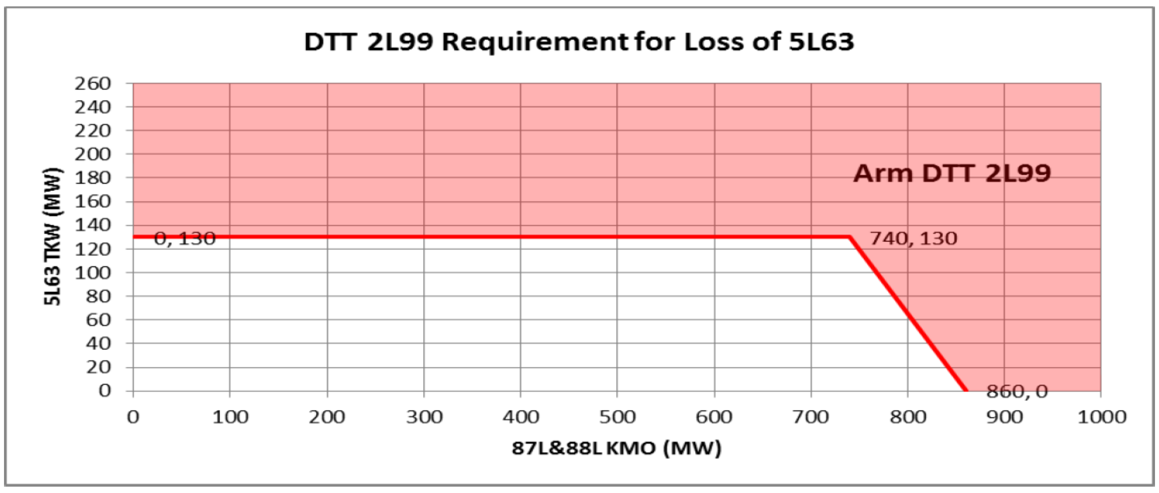
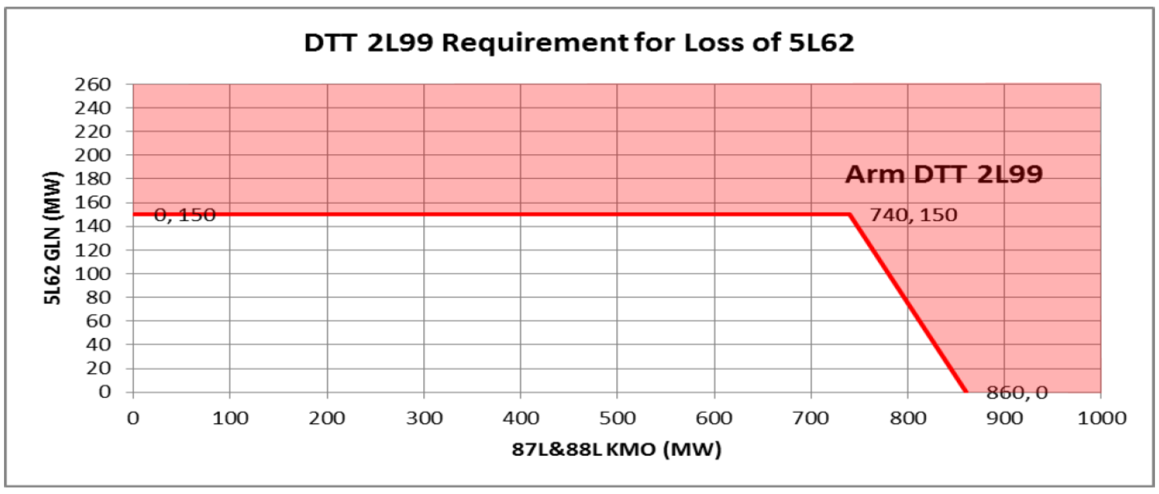



**Diagram 2.4**
**System Conditions (Notes 1 and 2):**
- 2L102 OOS



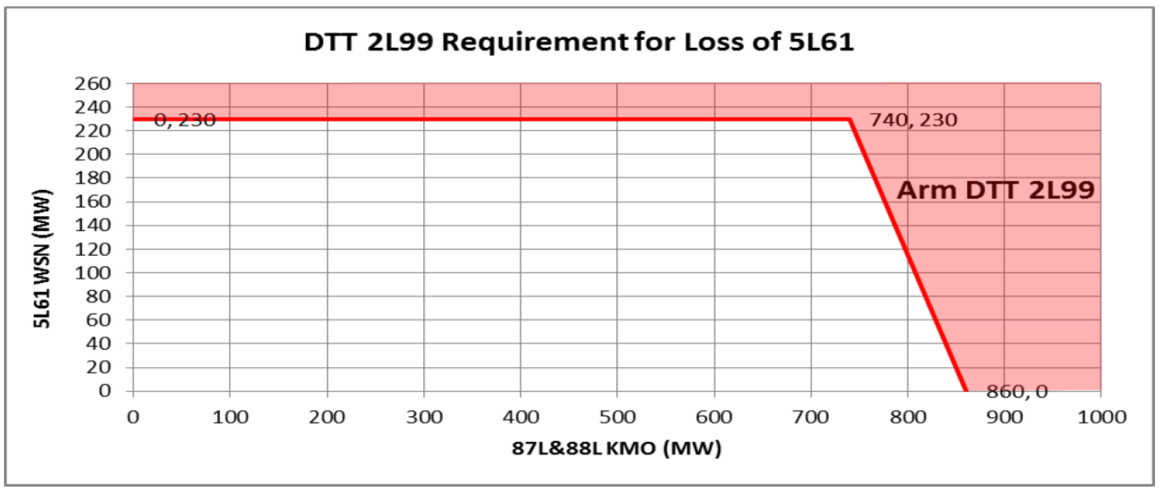
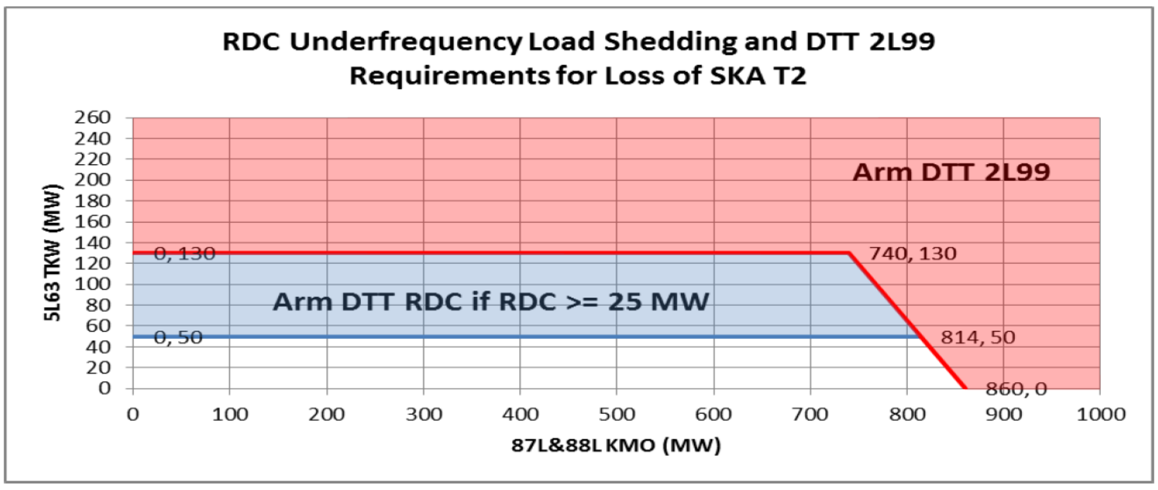
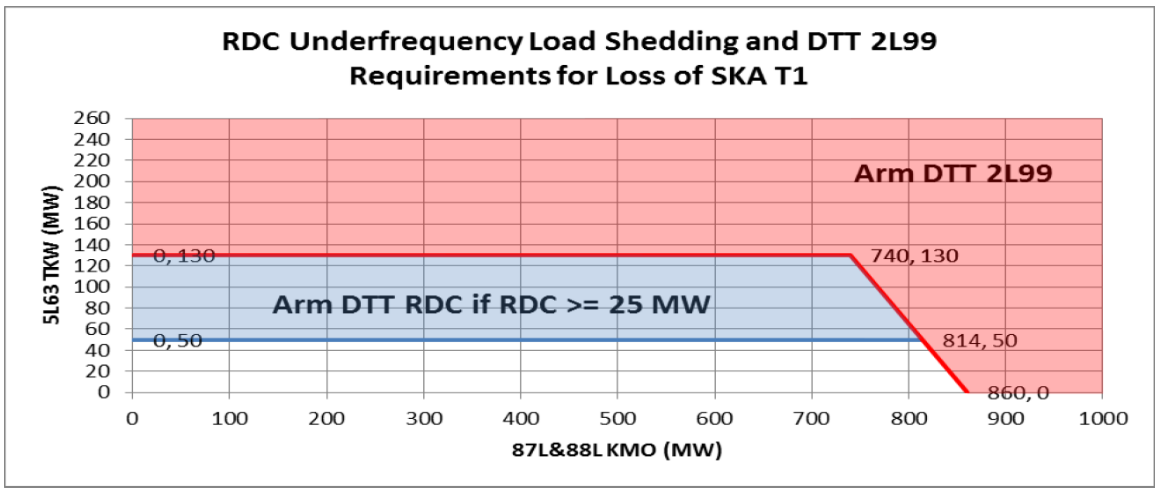




**Diagram 2.5**
**System Conditions (Notes 2 and 7):**
- SKA T1 OOS



**<u>Diagram 2.6</u>**
**System Conditions (Notes 2 and 7):**
- SKA T2 OOS



## Attachment 5 – Restoration from 5L61, 5L62, 5L63 Permanent Faults

### 1.0 Forecast Load and Generation Capacity

The tables below provide information on the expected Generation Capacity and the expected peak loads for Transmission Voltage Customer and Distribution customer stations.

**Table 1: North West Area Generation Capacity and Essential Load Level**

| North West Area Generation | Plant Capacity in MW |
|---|---|
| **Dependable Generating Plants:** | |
| KMO | 910.0 |
| FLS | 9.6 |
| RPG | 46.0 |
| Total Dependable Generation | 965.6 |
| **Independent Power Producers:** | **Plant Capacity in MW** |
| FKR | 211.4 |
| MCY | 70.7 |
| FGE | 42.5 |
| LNL | 34.7 |
| VOL | 17.6 |
| DSQ | 14.8 |
| FLB | 13.0 |
| MDL | 8.2 |
| BRL | 7.2 |
| **North West Essential Load (see below)** | |
| KIT Load | 550 - 750 |
| Transmission Voltage Customer | 14.59 |
| NW Area Substations | 220.4 |
| **Total load** | **785.3 to 985.29** |

**Table 2: North West Area Transmission Voltage Customers**

| North West Area Transmission Voltage Customers | Forecast Peak[(1)] (MW) | Forecast Peak[(1)] (MVar) | 10% of Peak (MW) | 10% of Peak (MVar) |
|---|---|---|---|---|
| AFP | 3.0 | 1.0 | 0.3 | 0.1 |
| BJT | 20.9 | 5.2 | 2.1 | 0.5 |
| EKO | 1.0 | 0.3 | 0.1 | 0.0 |
| EQU | 1.5 | 0.5 | 0.2 | 0.1 |
| EWL | 0.3 | 0.1 | 0.0 | 0.0 |
| FSS | 6.6 | 3.2 | 0.7 | 0.3 |
| HML | 2.4 | 0.8 | 0.2 | 0.1 |
| NHS | 16.2 | 5.3 | 1.6 | 0.5 |
| NLV | 9.1 | 3.0 | 0.9 | 0.3 |
| PBL | 8.4 | 2.8 | 0.8 | 0.3 |
| PLT | 9.2 | 3.0 | 0.9 | 0.3 |
| PRG | 7.2 | 3.5 | 0.7 | 0.3 |
| PRT | 1.4 | 0.5 | 0.1 | 0.0 |
| RDC | 47.5 | 15.6 | 4.8 | 1.6 |
| RTI | 7.5 | 3.6 | 0.7 | 0.4 |
| STF | 0.9 | 0.4 | 0.1 | 0.0 |
| TFP | 5.4 | 1.8 | 0.5 | 0.2 |
| WNR | 0.4 | 0.0 | 0.0 | 0.0 |
| **Total TVC Load** | **145.9** | **144.3** | **14.6** | **14.4** |

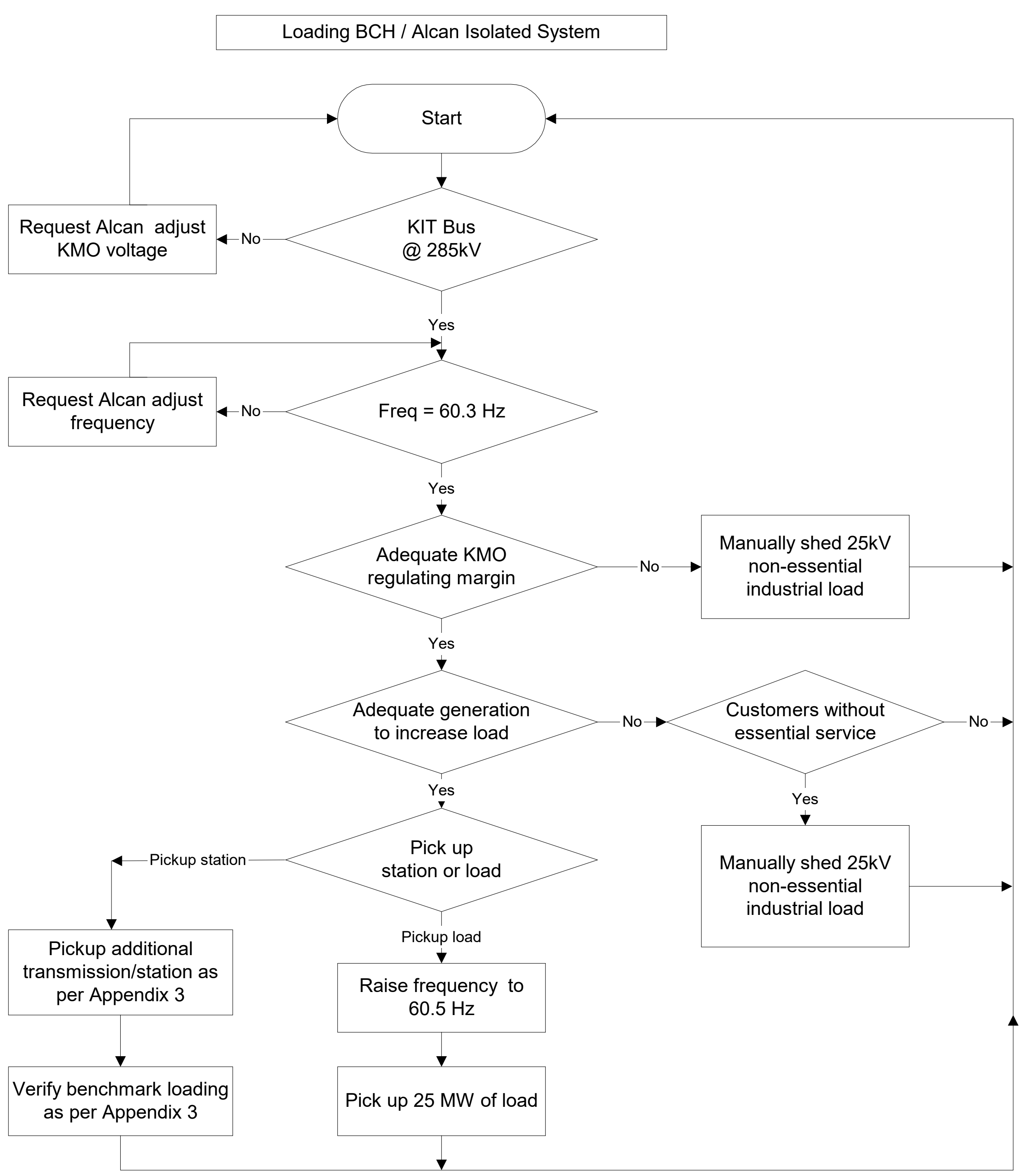
*Note (1): The forecast values in Table 2 is based on TVC Peak Forecast released in June 2019

**Table 3: North West Area BCH Stations Load**

| North West Area 25kV Distribution Sub Peak Load(2) | | | | |
|---|---|---|---|---|
| Distribution Substations | Winter Peak Load | | Summer Peak Load | |
| | MW | Mvar | MW | Mvar |
| AYH | 6.6 | 0.9 | 2.6 | 0.4 |
| BAB | 2.7 | 0.8 | 1.8 | 0.5 |
| BRN | 20.5 | 6.0 | 12.7 | 3.7 |
| DIL | 0.1 | 0.0 | 0.1 | 0.0 |
| FM2 | 8.7 | 2.2 | 4.3 | 1.1 |
| FSR | 5.6 | 1.1 | 2.4 | 0.7 |
| GRR | 0.1 | 0.0 | 0.1 | 0.0 |
| HUS | 9.5 | 3.4 | 6.3 | 2.3 |
| HZN | 13.3 | 1.9 | 5.8 | 1.2 |
| KAL | 25.9 | 7.6 | 15.2 | 4.4 |
| MEZ | 0.2 | 0.0 | 0.1 | 0.0 |
| MIN | 17.6 | 2.5 | 8.9 | 1.3 |
| OFD 12 kV | 17.1 | 4.3 | 8.7 | 2.2 |
| OFD 25 kV | 14.9 | 3.0 | 8.4 | 1.7 |
| PED | 3.0 | 1.0 | 2.0 | 0.7 |
| SRS | 35.2 | 5.0 | 18.6 | 2.7 |
| STW | 2.9 | 0.7 | 1.3 | 0.3 |
| TAT | 1.0 | 0.1 | 0.5 | 0.1 |
| TER | 14.8 | 4.3 | 8.6 | 2.5 |
| VDF | 20.6 | 2.9 | 9.8 | 1.4 |
| **Total Distribution Load** | **220.4** | **48.0** | **118.2** | **27.1** |

*Note (2): The winter peak and summer peak load values in Table 3 is based on Distribution Substation Load Forecast 2019 prepared by Distribution Planning

## 2.0 Load PU Sequence – Process




Flow Chart - Line/Load Pickup
5L61 Permanent Fault
BCH / Alcan Islanded System

## 3.0 North Coast Load Restoration Cases – Peak Winter & Peak Summer and VAR Support

### Table 1 – Winter Peak Load

**RTA & North West Area Restoration After 5L61 (or 5L62, or 5L63) Permanent Outage**

| System Conditions | | | | | Generation (MW) | | KIT Load | | 2L103 KIT flow | | 2L101 SKA Flow | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | Outage Circuit | | | Descriptions | KMO | RPG | MW | Mvar | P (MW) | Q (Mvar) | P (MW) | Q (Mvar) | KIT 287 | MIN 287 | SKA 287 | SKA 500 | TKW 500 | TKW 138 | GLN 230 | GLN 500 |
| 1 | 5L63 | 5L62 | 5L61 | Energize 2L103, MIN | 780 | - | 750 | 23.5 | 15 | 5 | - | - | 288.9 | 288.9 | - | - | - | - | - | - |
| 2 | 5L63 | 5L62 | 5L61 | Energize 2L99, SKA 230kV, SKA T4/T5/T6 | 853 | - | 750 | 23.5 | 86 | 86 | - | - | 289 | 288.6 | 279.3 | - | - | - | - | - |
| 3 | 5L63 | 5L62 | 5L61 | Energize 2L101 and Prince George Load | 830 | 46 | 750 | 23.5 | 65 | 63 | -22 | -22 | 288.7 | 288.5 | 281.6 | - | - | - | - | - |
| 4 | | 5L62 | 5L61 | Energize SKA T1/T2, TKW T2/T3/T4/T5 and 1L396 | 890 | 46 | 750 | 23.5 | 123 | -12 | -21 | -24 | 288.9 | 288.9 | 289.2 | 521.1 | 519.3 | 138.5 | - | - |
| 5 | | 5L62 | 5L61 | Energize 2L102, 2L374 | 905 | 46 | 750 | 23.5 | 134 | -66 | -21 | -25 | 289.1 | 289.3 | 294.8 | 531.3 | 529.4 | 141.2 | - | - |

Study Conditions:

1. Distribution winter peak load (220MW) with 10% industrial load (15 MW)

**Table 2 – Summer Peak Load**

**RTA & North Coast Area Restoration After 5L61 (or 5L62, or 5L63) Permanent Outage**

Summer Peak Load Condition

70% Distribution Load (155MW) & 10% Industrial Load (24MW)

| System Condition | | | | | Generation (MW) | | KIT to MIN flow | | SKA to RPG flow | | Bus Voltages (kV) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | Outage Circuit | | | benchmark stages | KMO | RPG area | P (MW) | Q (Mvar) | P (MW) | Q (Mvar) | KIT 287 | MIN 287 | SKA 287 | SKA 500 | TKW 500 | TKW 230 | GLN 500 | GLN 230 |
| 1 | 5L63 | 5L62 | 5L61 | connect 2L103 & MIN area loads | 612.1 | n/a | 23.5 | 6.3 | 0 | 0 | 285.6 | 285.5 | | | | | | |
| 2 | 5L63 | 5L62 | 5L61 | connect 2L99 & SKA66 loads | 642.9 | n/a | 53.5 | 2.6 | 0 | 0 | 285.6 | 285.5 | 284.8 | | | | | |
| 3 | 5L63 | 5L62 | 5L61 | connect 1L387 loads | 650.6 | n/a | 61.2 | -14.6 | 0 | 0 | 285.6 | 285.5 | 286.5 | | | | | |
| 4 | | 5L62 | 5L61 | connect 5L63 at SKA (no load @ TKW) | 650.8 | n/a | 61.4 | -72.3 | 0 | 0 | 285.6 | 285.8 | 292.6 | 525.2 | 521.7 | | | |
| 5 | | 5L62 | 5L61 | connect 1L385 loads | 692.1 | n/a | 102 | -59.7 | 0 | 0 | 285.6 | 285.8 | 290.9 | 521.7 | 517.1 | 232.2 | | |
| 6 | | 5L62 | 5L61 | connect 1L396 loads | 701.3 | n/a | 111 | -61.9 | 0 | 0 | 285.6 | 285.8 | 291.1 | 522.2 | 517.8 | 232.6 | | |
| 7 | | | 5L61 | connect 5L62 at TKW (no load @ GLN) | 701.6 | n/a | 111 | -108 | 0 | 0 | 285.6 | 286 | 295.9 | **533** | **532.6** | 239.3 | 528.8 | |
| | | | | **2 RPG units in service** | | | | | | | | | | | | | | |
| 8 | | | 5L61 | connect 2L353 loads | 689.2 | 59 | 98.9 | -116 | -24.8 | 4.4 | 285.6 | 286 | 296.9 | 535.2 | 535.8 | 240.8 | 532.8 | 239.9 |
| 9 | | | 5L61 | connect 1L384 loads | 708 | 59 | 117 | -118 | -24.8 | 4.5 | 285.6 | 286 | 297 | 535.6 | 536.5 | 241.1 | 533.8 | 240.4 |
| 10 | | | 5L61 | connect GLN 66kV loads | 715.4 | 59 | 124 | -116 | -24.8 | 4.3 | 285.6 | 286 | 296.7 | 535 | 535.7 | 240.7 | 532.8 | 239.9 |
| | | | | **1 RPG units in service** | | | | | | | | | | | | | | |
| 01-Aug | | | 5L61 | connect 2L353 loads | 713 | 36 | 122 | -123 | -2 | -5.4 | 285.6 | 286 | 297.5 | 536.3 | 536.8 | 241.2 | 533.9 | 240.4 |
| 01-Sep | | | 5L61 | connect 1L384 loads | 731.8 | 36 | 140 | -126 | -2 | -5.4 | 285 | 285.5 | 297.1 | 535.8 | **537.7** | 241.1 | 534 | 240.5 |
| 01-Oct | | | 5L61 | connect GLN 66kV loads | 739.1 | 36 | 147 | -124 | -2 | -9.9 | 285.6 | 286 | 297.4 | 536.2 | 536.8 | 241.2 | 534 | 240.5 |
| | | | | **0 RPG units in service** | | | | | | | | | | | | | | |
| 8-0 | | | 5L61 | connect 2L353 loads | 737 | 13 | 145 | -137 | 20.9 | -22.8 | 283.8 | 284.4 | 297.2 | 535.8 | **536.3** | 241 | 533.4 | 240.1 |
| 9-0 | | | 5L61 | connect 1L384 loads | 755.8 | 13 | 163 | -140 | 20.9 | -22.8 | 283.3 | 283.8 | 296.8 | 535.3 | **536.2** | 240.9 | 533.5 | 240.3 |
| 10-0 | | | 5L61 | connect GLN 66kV loads | 763.2 | 13 | 171 | -137 | 20.9 | -22.7 | 283.6 | 284.1 | 296.8 | 535.1 | **535.8** | 240.8 | 532.9 | 240 |
| **SKA 2 x 37.5 Mvar Shunt RXs energized** | | | | | | | | | | | | | | | | | | |
| 7.rx | | | 5L61 | connect 5L62 at TKW (no load @ GLN) | 701.3 | n/a | 111 | -28.3 | 0 | 0 | 285.6 | 285.6 | 287.6 | 517.8 | 517.3 | 232.4 | 513.7 | |
| | | | | **2 RPG units in service** | | | | | | | | | | | | | | |
| 8.rx | | | 5L61 | connect 2L353 loads | 688.9 | 59 | 98.5 | -42.1 | -24.7 | -2.4 | 285.6 | 285.7 | 289.1 | 521.1 | 521.6 | 234.4 | 518.7 | 233.5 |
| 9.rx | | | 5L61 | connect 1L384 loads | 707.6 | 59 | 117 | -45.1 | -24.8 | -2.3 | 285.6 | 285.7 | 289.3 | 521.6 | 522.4 | 234.7 | 519.8 | 234.1 |
| 10.rx | | | 5L61 | connect GLN 66kV loads | 715 | 59 | **124** | -42.3 | -24.8 | -2.6 | 285.6 | 285.7 | 289 | 520.9 | 521.4 | 234.3 | 518.6 | 233.5 |
| | | | | **1 RPG units in service** | | | | | | | | | | | | | | |
| 8-1.rx | | | 5L61 | connect 2L353 loads | 712.4 | 36 | 121 | -48.1 | -2.1 | -9.7 | 285.6 | 285.7 | 289.6 | 522 | 522.4 | 234.7 | 519.6 | 233.9 |
| 9-1.rx | | | 5L61 | connect 1L384 loads | 731.1 | 36 | 140 | -50.9 | -2.1 | -9.7 | 285.6 | 285.7 | 289.8 | 522.5 | 523.3 | 235.1 | 520.7 | 234.5 |

| <u>**Table 2 continued from previous page**</u> | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-1.rx | | | 5L61 | connect GLN 66kV loads | 738.6 | 36 | **147** | -47.9 | -2.1 | -9.8 | 285.6 | 285.7 | 289.4 | 521.7 | 522.2 | 234.6 | 519.4 | 233.9 |
| | | | | **0 RPG units in service** | | | | | | | | | | | | | | |
| 8-0.rx | | | 5L61 | connect 2L353 loads | 736.2 | 13 | 145 | -57.9 | 20.9 | -21.1 | 285.6 | 285.7 | 290.5 | 523.6 | 524.1 | 235.5 | 521.2 | 234.7 |
| 9-0.rx | | | 5L61 | connect 1L384 loads | 755 | 13 | 163 | -60.5 | 20.9 | -21.2 | 285.6 | 285.8 | 290.6 | 524.1 | 524.9 | 235.8 | 522.3 | 235.2 |
| 10-0.rx | | | 5L61 | connect GLN 66kV loads | 762.4 | 13 | **170** | -57.7 | 20.9 | -21.6 | 285.6 | 285.7 | 290.3 | 523.4 | 523.9 | 235.4 | 521.1 | 234.7 |

Note:

1. RPG area generation: total 59MW (RPG 2 x 23MW, FLS 2 x 3.5MW; BRL 6MW)
2. SKA 12RX1 (37.5Mvar) 12RX2 (37.5 Mvars) TKW 12RX2 (75 Mvars) and TKW 12RX3 (75Mvars) are all de-energized unless otherwise noted.
3. 5L62 & 5L63 line end RXs are energized with the lines.
4. 2L101 connection between SKA and RUP could be made at the last stage after connecting the GLN 66kV loads as the total KIT to MIN flow is below 175MW, System Condition 10.
5. All the distribution loads and essential transmission customer loads can be supplied with no RPG unit in service, System Condition 10-0.
6. During light load period, after energizing 5L62 (System Condition 7) 12kV RXs at SKA should be energized to reduce the 500kV system voltage.

## 4.0 25 kV Industrial Loads

**25 kV Industrial Load**
(Peak Load Greater than 1.0 MW)

| Station | Feeder | Customer Name | Peak Load (MW) | Load Shed (MW) |
|---|---|---|---|---|
| AYH | 2551 | NISGA'A LISIMS GOVT FISHERIES DEPT - NISGA'A LISIMS GOVT FISHERIES DEPT STORAGE | 2 | 1.5 |
| AYH | 2551 | NISGA'A VILLAGE OF GINGOLX | 2.5 | 0.5 |
| AYH | 2551 | LISIMS FOREST RESOURCES LTD PARTNERSHIP | 3.5 | 1 |
| AYH | 2551 | FISHERIES AND OCEANS CANADA | 2 | 0.5 |
| BRN | 2553 | BABINE FOREST PRODUCTS LTD | 2 | 1.5 |
| BRN | 2554 | DECKER LAKE FOREST PRODUCTS LTD | 1 | 0.75 |
| HUS | *** | WEST POINT RAIL & TIMBER CO LTD | 2 | 1.5 |
| KAL | *** | SKEENA SAWMILLS LTD | 3.5 | 2.5 |
| KAL | *** | SKEENA SAWMILLS LTD | 2 | 1.5 |
| SRS | *** | SMITHERS PELLET INC | 1.1 | 0.8 |