Generation Reliability

- Background
  - Hydroelectric structures have lifetimes of 100+ years, but most equipment (generators, exciters, turbines, governors, transformers and circuit breakers) has a shorter life span (25-35 years)
  - Lifetime will vary with design and operating environment (starts/stops, unit loading, ramping, etc.), maintenance practices and other factors
    - Peace Canyon and Mica generators have design deficiencies, that were initially managed through maintenance programs and operating practices
    - Large unit sizes at GM Shrum, Peace Canyon, & Mica were near limits of technology at time of their design
  - Technology improvements may justify replacement of generator windings, turbine runners, circuit breakers, governors prior to end of life

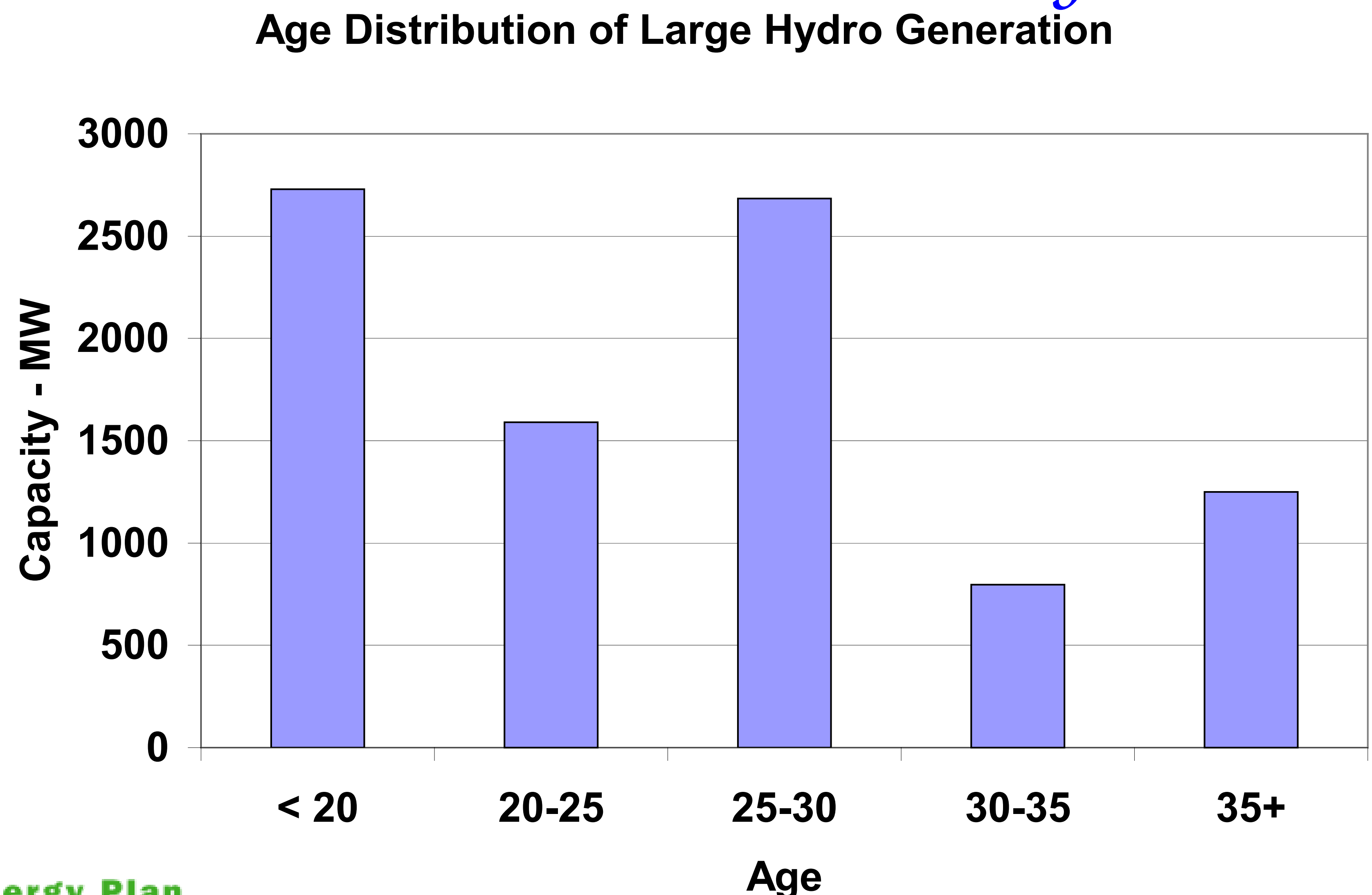
Generation Reliability

- Impact of Poor Reliability
  - Planning perspective
    - System is designed to provide a reliable supply to end use customer
    - Higher unit forced outage rates must be compensated by higher planning reserves, accelerating the need for new resources
  - Operational considerations
    - Unit unavailability may increase spill and/or reduce opportunities to engage in electricity trade. Impact is a higher cost of energy or reduced trade income, resulting in higher costs for customers
    - Generation monitors outage statistics for benchmarking against other utilities and commercial performance measures to analyze the dollar impact of outages
  - Equipment cost Impacts
    - Maintenance costs
    - Sustaining capital costs

Generation Reliability

- Reliability Centered Maintenance
  - Methodology to review and revise maintenance standards
  - Objective is to ensure maintenance standards (and therefore maintenance costs) are based on optimum balance of cost and risk and are consistent across similar facilities
    - Right maintenance at right time (frequency)
    - Less maintenance required if equipment is not critical to performance of the unit
  - Also provides a structured process for transferring knowledge from experienced to new workers
  - Meets Worker's Compensation Board regulations requiring maintenance be performed in accordance with instructions from the equipment manufacturer or as approved by a professional engineer

Generation Reliability



Generation Reliability

- Equipment Health Rating
  - Standardized condition assessment process for reporting on equipment condition. Separate assessments are conducted for major components (generators, exciters, turbines, governors, transformers and circuit breakers) and for protective coatings.
    - Structured process that considers outage performance, availability of spare parts and technical support, and design considerations (known problems, complexity, technology,etc)
    - Assigns a letter grade (good, fair, poor or unsatisfactory)
    - Includes technical recommendations to restore the equipment to good health, maintenance procedures and timing to address health issues or recommendations for replacement
  - Draft assessments have been performed for all equipment at large hydro and for generators at all plants(see Schedule 5-3 of Application Vol. 1). Work is ongoing to enhance the product to assist in prioritization of capital expenditures

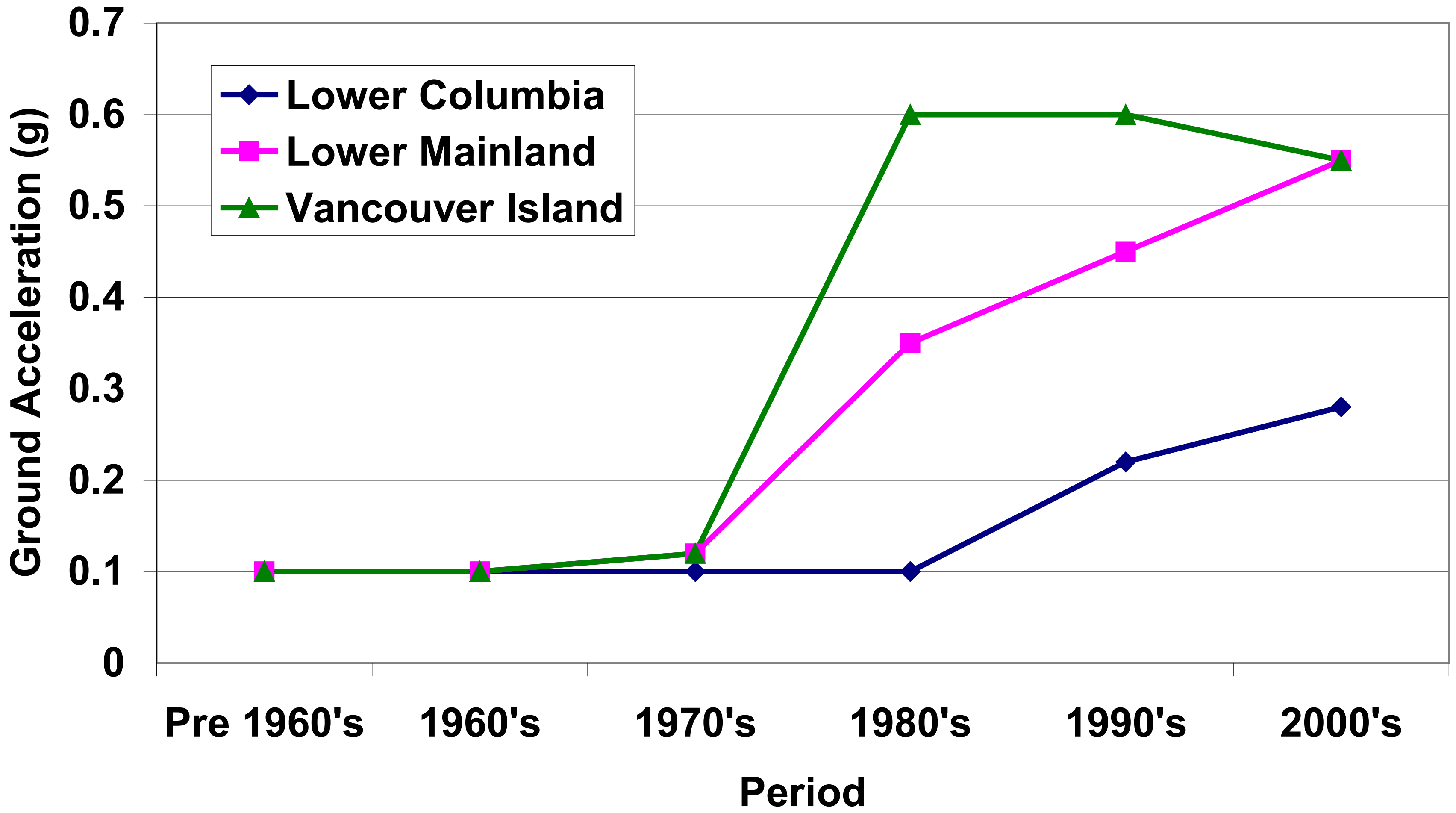
Generation Reliability

- Current priorities
  - GM Shrum #7 - restore failed unit
  - Peace Canyon generators - correct design deficiencies that put units at risk of extended outages
  - Mica stator replacements - similarly to correct design deficiencies that put units at risk of extended outages
  - GM Shrum #1-4 - generator rewind - Recent tests indicate unit #4 winding condition has deteriorated and should be replaced. Units 1-3 are similar vintage and will be inspected to determine to determine if they require replacement as well
  - GM Shrum #1-5 turbine replacement - design deficiencies have been managed through more frequent inspection and repair. Replacement will reduce maintenance requirements and provide small efficiency gains

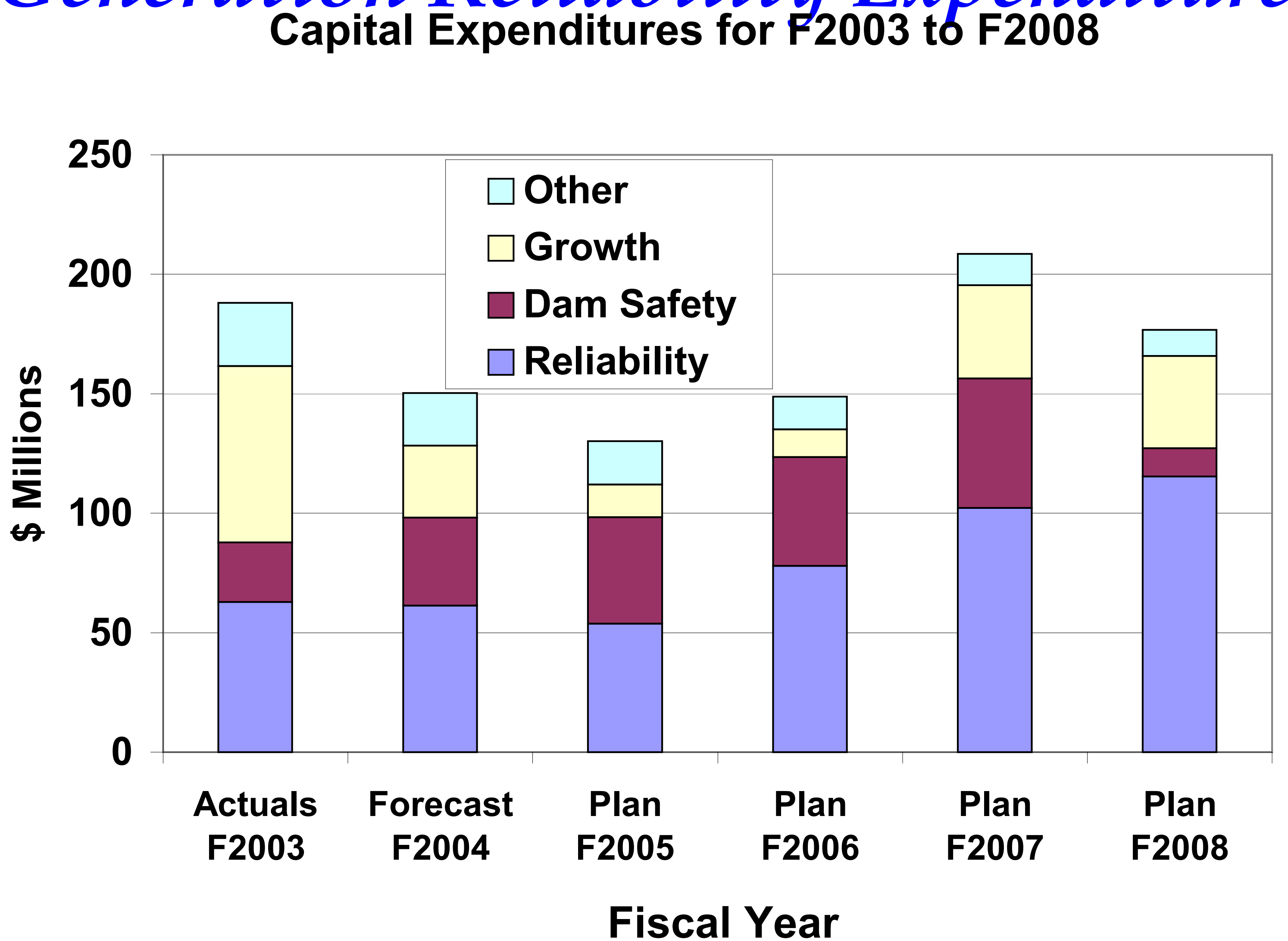
Generation Reliability

- Dam Safety Program
  - Structured process to identify, evaluate and correct deficiencies at existing BC Hydro facilities
  - Address increased seismic standards approved by the dam safety regulator (Comptroller of Water Rights)
  - Address ageing and performance issues
  - Solutions are dam specific, but may involve decommissioning, anchoring, strengthening or dam replacement
  - Operational constraints (maximum reservoir elevation) are evaluated as temporary measures (Coquitlam, Elsie)
- Priorities
  - Seven Mile (anchoring, structural and reliability improvements)
  - Coquitlam (dam replacement)
  - Elsie Lake, Ruskin dam, Blind Slough dam, LaJoie, Strathcona (dam strengthening, anchoring and other improvements)

Escalation of Seismic Standards
Maximum Design (Credible) Earthquake



Generation Reliability Expenditures



Generation Expenditure Summary

Operating, Maintenance and Adminstration Costs*
(in millions of dollars)

	F2003 Actual	F2004 Forecast	F2005 Plan	F2006 Plan
Operations		19.4	18.9	20.7
Maintenance		48.3	53.4	53.5
General and Administration		58.3	53.1	51.8
Total Generation	119.5	126.0	125.4	126.0

*F2003 costs are not available in the same categories as subsequent years due to accounting and restructuring changes that occurred post F2003

Generation Expenditure Summary

Generation Capital Plan F2004 – F2006
(in millions of dollars)

	F2004 Forecast	F2005 Plan	F2006 Plan
Total Sustaining Capital	120	116	137
Total Growth Capital	30	14	12
Total Capital Expenditures	150	130	149