



**POWER GENERATION -
EXPLORING
SASKATCHEWAN'S NUCLEAR
FUTURE**

**Presented to the SARM and U of R Forum
January 18, 2006**

Generation Integration Issues

- Integrating large generators into SaskPower's system
- Two levels of concern
 - Impact on the local transmission system
 - Impact on interconnected operation with other transmission systems

Generation Integration Issues

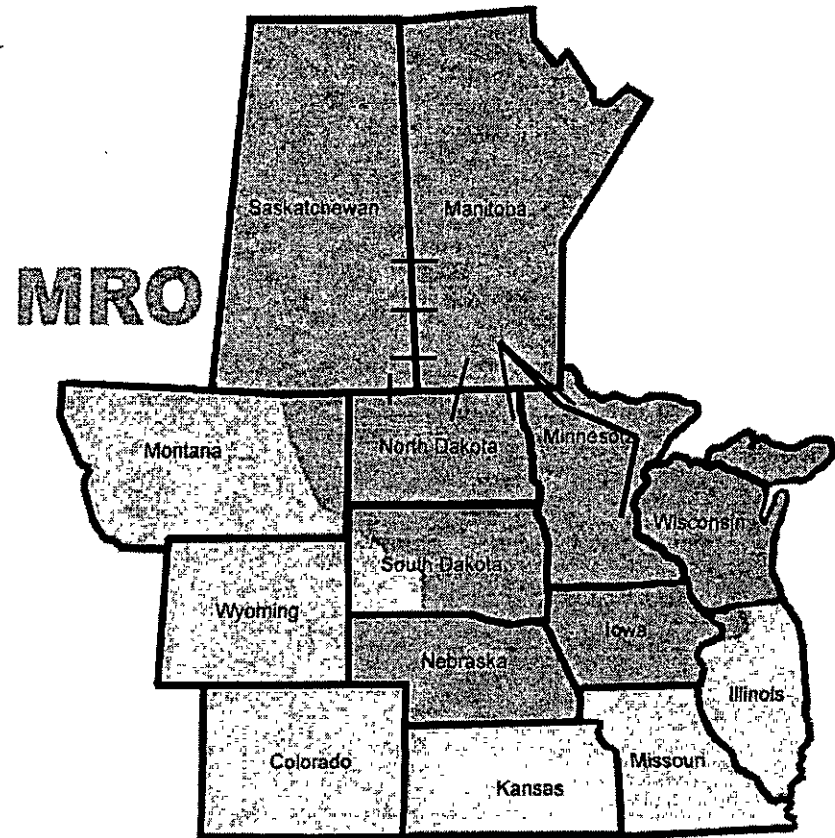
- Impact on the local transmission system
- A nuclear unit in the context of SaskPower's system
 - SaskPower's peak system load is 2954 MW (2004)
 - SaskPower's minimum system load drops to about 1500 MW
 - SaskPower's biggest unit is ~ 300 MW
 - Current round of economical nuclear unit sizes are > 1000 MW
 - One nuclear unit is greater than all of SaskPower's coal-fired generation located in Estevan area (7 units)

Generation Integration Issues

- Impact on the local transmission system
 - No single load center in Sask. equivalent to current nuclear unit size (especially at light load) - require multiple new lines to multiple delivery points and upgrades to existing transmission
 - 230 kV currently max line voltage in Sask. 1000+ MW would require ~ 6 – 230 kV lines.
 - Routing and cost issues with 6 230 kV circuits may precipitate move to 345 kV or 500 kV for a green-field nuclear site
 - Will add significant operating cost because of requirement to maintain contingency generating reserve equal to largest unit

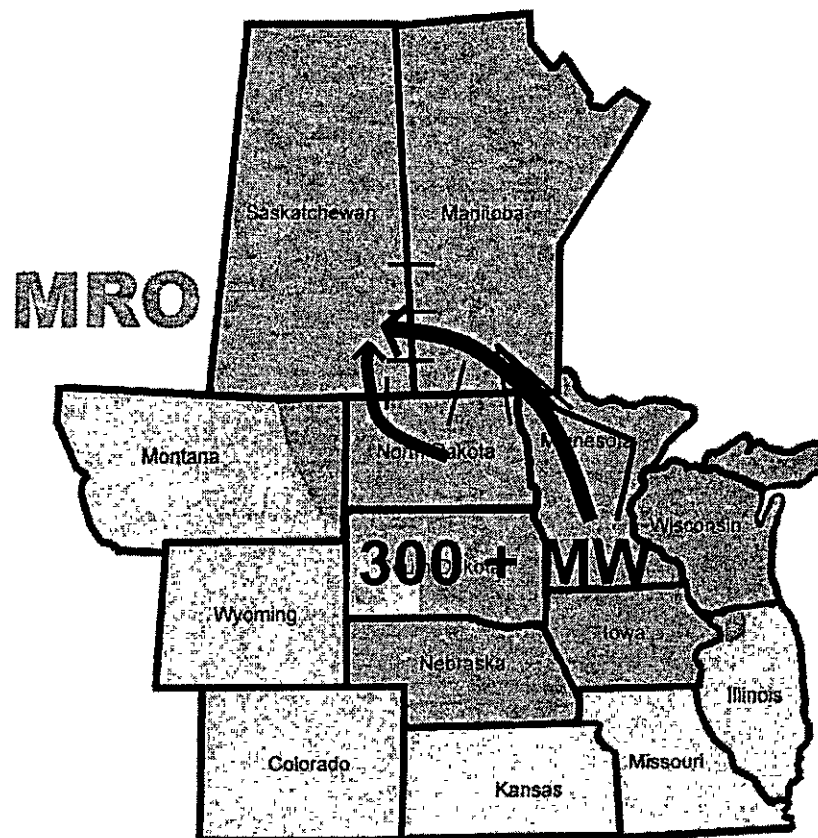
Generation Integration Issues

- Impact on the interconnected transmission system
 - SaskPower synchronously integrated with Manitoba, North Dakota and all of eastern North America



Generation Integration Issues

- Impact on the interconnected system
 - When a SP unit trips, 99 % of lost power instantly comes in over the interconnections
 - System and interconnections sized to withstand loss of largest SP unit (~300 MW) without service disruption

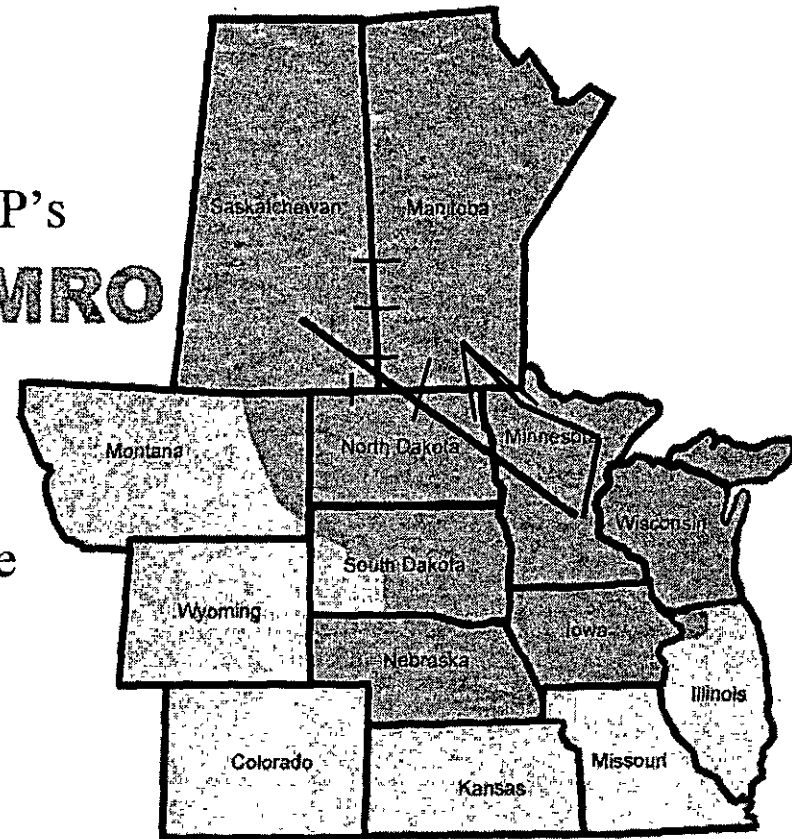


Generation Integration Issues

– Impact on the interconnected system

- Nuclear unit 300+ % larger than SP's largest
- Require 300+ % increase in interconnection capability to accommodate loss of nuclear unit
- Reenforcement requirements ripple through northern MRO
- Likely require new 500 kV transmission for interconnection reenforcement (\$ 0.7 B)

MRO



Build For Export

- Two possible options:
 - Unit integrated into Sask. System with partial sales to external market
 - Unit located in Sask. but isolated from Sask. system. Dedicated transmission to external markets.

Build For Export

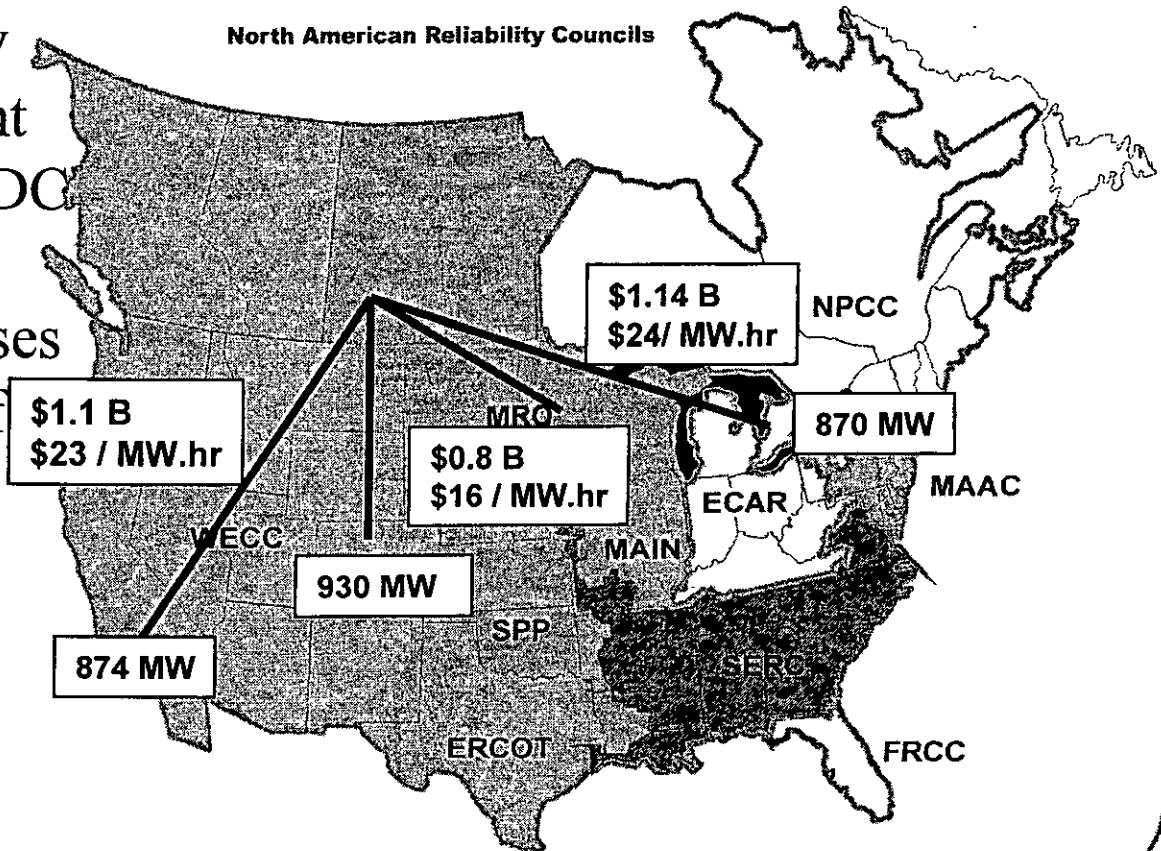
- Mixed domestic supply & external sales option
 - Still have to deal with all of the issues associated with integrating unit into Sask. transmission system
 - Local transmission reinforcement
 - Reinforcement of interconnections to facilitate loss of unit
 - Depending on how much is being sold to external market, may require interconnection reinforcement beyond what is required to just address loss of unit
 - Additional transmission costs if market is not within MRO

Build For Export

- Build for export only
 - Utilize High Voltage Direct Current (HVDC) transmission to connect to external markets
 - HVDC provides lowest cost and operational flexibility for distances and power levels under consideration
 - Build for export only avoids local transmission problems

Build For Export

- Build for export only
- Utilize Direct Current Transmission to HVDC
- Includes capital, maintenance and losses
- Cost is 20 ~ 30 % of delivered cost of energy



Cost of Transmission for Export

- Build for export only
- Cost to closest market capable of sinking 1000 MW
- Based upon +/- 500 kV bipolar HVDC
- Includes capital, maintenance and losses
- Cost is 20 ~ 30 % of delivered cost of energy

