GENERATOR TESTING AND CONDITION ASSESSMENT







Hydropower Variety is the Spice of Life

- □ Generator Configurations Voith Video
 - Vertical, Horizontal, Angled
 - Synchronous
 - Reversible
 - Variable Speed
- □ Cooling
 - Air, Water, Water Cooled Air
- □ Windings
 - Coils Form wound VPI, Resin rich
 Bars
- □ Voltage
 - 2.3 kV to 20+ kV, 25 Hz-60 Hz

Generator Design Life vs Actual Life

"Typical" Hydroelectric Unit Design Life: 30-50 years

- □ Design parameters
 - Starts and Stops
 - Transient events
 - Voltage
 - Temperature
 - Load
- □ Actual life varies based on use/abuse

Reasons for Generator Degradation

1. Heat

Overloaded

Loss of cooling

Local damage – hot spots

2. Partial Discharge/Corona

Overvoltage

Insulation breakdown

Poor installation

3. Contamination

Oil

Water

Dust/Debris

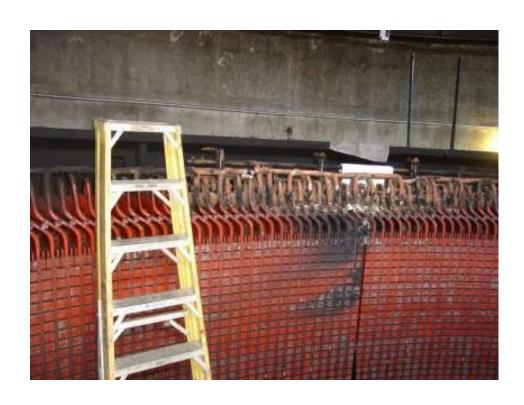
4. Mechanical Damage

Foreign material

Fatigue

Vibration

Winding Failures



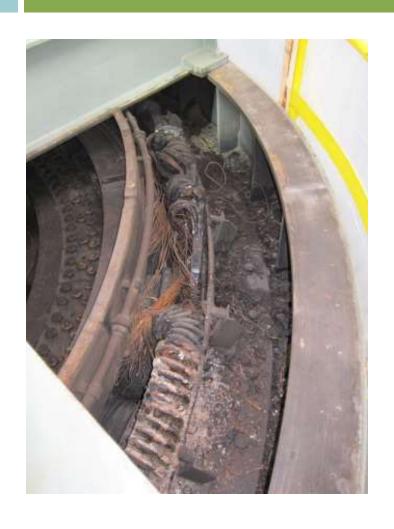


Winding Failures





Winding Failures





Contamination





Mechanical Damage



Mechanical Damage





Mechanical Damage



Failure Prevention

- □ Rotor and Stator Inspection
 - Regular annual is recommended
 - After significant events
 - Load rejections
 - Short circuits
 - Synch out of phase
 - Runaway
- Cleaning

Failure Prevention

- Periodic Testing
 - Heat Runs (Temperature Rise)
 - Polarization Index
 - Maintenance Level High Potential
 - Partial Discharge
 - Core Loop
 - El Cid
- Data Trending

GENERATOR AIR COOLER COOLING WATER FLOW RATE DATA

Air Cooler CW Flow Total	gpm	1000
Cooler 1	gpm	125.2
Cooler 2	gpm	110.2
Cooler 3	gpm	280.7
Cooler 4	gpm	275.8
Cooler 5	gpm	197.4
Cooler 6	gpm	95.5
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Addressing Potential Failures

- □ Spares
- □ Planned Refurbishment
 - Windings
 - Core
 - Clamping System
 - Pole Re-insulation
- Advance Equipment Purchase/Storage
- Combine with Unit Upgrade