

Nuclear Safety

Module 5

GUARANTEED SHUTDOWN STATE (GSS)

Slide 1

What is the GSS?

- **Criticality impossible despite worst case failures**
- **Negative reactivity load sufficient to counteract**
 - Fission product decay
 - Plutonium build-up
 - Temperature coefficients of reactivity
 - all reactivity mechanisms in most reactive state
 - dilution of moderator poison due to PT/CT rupture
- **Condition guarantees to prevent net removal of negative reactivity**

Slide 2

When is the GSS Required?

- RRS unable to control reactor power
- SDS impaired and cannot be returned to service within grace period
- ECI or Containment removed from service

Slide 3

Why is the GSS Required?

- to prevent a LORA when RRS or SDS impaired
- ensures CONTROL when normal and backup CONTROL, COOL, or CONTAIN methods are unavailable

Slide 4

Methods of Achieving the GSS

- 1) **Overpoisoned moderator**
- 2) **Moderator drained**
- 3) **Moderator Dumped (Pickering-A only)**

Slide 5

1) Overpoisoned Moderator GSS

- Gd added to moderator
- HTS depressurized to reduce risk of in-core LOCA diluting moderator poison
- All means of adding reactivity defeated:
 - moderator purification isolated
 - pH measured frequently and controlled <6 to prevent poison precipitation
 - D₂O makeup to Moderator system isolated

Slide 6

2) Moderator Drained GSS

- calandria drained
- makeup isolated
- HTS cold depressurized
 - Can't risk filling calandria with (unpoisoned) HT D₂O
- 'hole' in system below calandria level

Slide 7

3) Moderator Dumped (Pickering-A only)

- **Condition guarantee prevents moderator pump-up**
 - Cover gas compressors isolated
 - He pressure regulating valves open
- **PHT loop interconnect valves closed**
 - limits D₂O entering calandria/dump tank system to roughly half PHT inventory
- **Total D₂O inventory in PHT storage tank plus moderator dump tank limited**
 - prevents D₂O backing up into calandria in event of in-core LOCA

Slide 8

Precautions While in GSS

- Positions of all guaranteed devices checked frequently (typically daily)
- Neutron flux monitored continuously
- At least one SDS kept poised (except in drained state at some stations)
- PHT system cold, depressurized

Slide 9

Additional Precautions

Overpoisoned GSS:

- moderator poison concentration and pH measured frequently to confirm within safe limits
- moderator circulated continuously

Moderator Dumped (Pickering-A only):

- PHT storage tank and moderator dump tank levels monitored to confirm total inventory within limits

Slide 10

Responsibilities of GSS Holder of Record

To ensure that:

1. condition guarantees are not violated
2. unit status is OK prior to surrendering GSS

**The Operations Manager is the Holder of Record to
ensure effective administrative control**