ACME NucPower Procedure			OPS-N-0002-B
Title:	**ACME NucPower Unit 1 Reactor Shut down**		
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A	1 Jan 2025	R.J.Smith	J. Hancock	First draft	Draft
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Summary

This procedure provides a step by step instruction for ACME NucPower Unit 1 Reactor controlled shut down. It shall be used as a reference each time this plant is started and a record kept of plant start up progress and any issues, events or error for future improvements.

The reactor has 5 operating modes as described below;

Mode 5 Cold shutdown - reactor is sub-critical with 0% power output and primary coolant average temperature < 95 degC.

Mode 4 Hot shutdown - reactor is sub-critical with 0% power output and primary coolant average temperature is > 95 degC and < 176 degC.

Mode 3 Hot standby - reactor is sub-critical with 0% power output and primary coolant average temperature > 176 degC.

Mode 2 Startup - reactor is critical with power output < 5%.

Mode 1 Power operations - reactor is critical with power output > 5%.

Shut Down procedure

The following is an operations procedure to take the plant from a Power Operation (Mode 1) at or near Reactor 100% power down to Hot Standby (Mode 3).

- Reactor critical at Mode 1 (Power Operations).
- Steam Turbine is IN SERVICE.

The step by step procedure below should now be followed to start the reactor in a safe manner.

1. BORATE primary circuit boron concentrations until reactor load is = 50%.
2. STOP Feedwater Pump 4 (01LAC40AP001).
3. START Feedwater Pump 1 (01LAC10AP001).
4. STOP Feedwater Pump 3 (01LAC30AP001).
5. BORATE primary circuit boron concentrations until reactor load is = 30%.
6. STOP Feedwater Pump 2 (01LAC20AP001).

7. BORATE primary circuit boron concentrations until reactor load is = 22 to 25%.

8. STOP Steam Turbine (01MAA10AH002).

   - Steam Turbine Steam Admission Control Valve (01MAA10AA002) will start to CLOSE to reduce Steam Turbine Load. Simultaneously Turbine Bypass Valves (01LBA60AA251 and 01LBA60AA252) will OPEN to ensure steam generated by Reactor has a flow path.
   - Once Steam Turbine Steam Admission Control Valve (01MAA10AA002) is CLOSED, Steam Turbine will TRIP.
   - Steam Turbine Emergency Stop Valve (01MAA10AA001) will CLOSE.
   - Generator Circuit Breaker (01MKA10GS001) will OPEN.
   - Generator Excitation OFF.
   - Steam Turbine speed will reduce to 30 rpm.
   - Steam Turbine Turning Gear will START and maintain turbine at 30 rpm.

9. INSERT Reactor control rods 01JDA20CG001, 01JDA20CG002, 01JDA20CG003, 01JDA20CG004 step by step (pulse) until Reactor power < 20%

10. PRESS Reactor SCRAM button.

11. CHECK all Protection and Control Rods are at 100% position (i.e. fully inserted).

12. MONITOR Bypass valves (01LBA60AA251/252) slowly closing to dump residual steam from Steam Generator.

13. MONITOR Steam Generator outlet PORV's (01LBA10/20/30/40AA501) OPEN.

14. WAIT until Bypass valves (01LBA60AA251/252) are FULLY CLOSED.

15. BREAK Condenser Vacuum (01MAJ10AH001).

16. WAIT until Condenser Pressure (01MAG10CP901) is > 900 mbar.

17. STOP Gland Steam System (01MAW10AH001). This will initiate the following sequence;

    - Gland steam pressure control valve (01MAW10AA151) will SELECT to MANUAL and CLOSE.
    - Gland Steam pressure (01MAW20CP001) will decrease to ZERO.
    - Gland steam supply isolation valve (01MAW20AA001) will CLOSE.
    - Gland steam exhauster fan (01MAW30AN151) will STOP.

Hot Standby (Mode 3) Achieved

Reactor is now at Mode 3 condition - Hot Standby. If the plan is to restart the plant within the next 24 hours we can maintain the plant at this condition.

However if the plan is for a longer shutdown or even a maintenance outage or reactor refuelling we should continue with the Reactor cool down so as to reach Mode 5 condition - Cold Shutdown.