SAMG-1 PRIMARY CONTAINMENT FLOODING

E Flooding Systems

■ Group 1:
- Condensate/Feedwater (QCOP 3200-09)
- CRD (QCOP 0300-16)
- Safe Shutdown from CCST (QCOP 2900-02)
- RCIC (QCOP 1300-02)
  - ☛ OK to defeat high torus water level isolation
- LPCI (QCOP 1000-30)
  - ☛ Use H2a as soon as possible

■ Group 2:
- SBLC from boron tank (QCOP 1100-02)
- SBLC from test tank (QCOP 1100-08)
- CRD crosstie (QCOP 0300-19 (33))
- Standby Coolant (QCOP 3200-09)
- Condensate crosstie (QCOP 3300-12)
- Core Spray (QCOP 1400-02)
- Safe Shutdown from Fire System (QCOP 2900-02)
- Fire System through Safe Shutdown (QCOP 4100-10)
- Fire System through RHR (QCOP 4100-11)
- ECCS Keep Fill (QCOP 1400-06)
- HPCI Cooling Water Pump (QCOP 2300-10)

F RPV Vent Systems

- Main turbine bypass valves (QCOP 0250-01)
- Main steam line drains (QCOP 0200-05)
- HPCI steam line drains (QCOP 2300-11)
- RCIC steam line drains (QCOP 1300-11)

☛ RPV breached; containment flooded to 4 ft above drywell floor.
☛ Keep debris in primary containment submerged.

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Operate Core Spray.
2. Control primary containment water level between 28 ft (4 ft above drywell floor) and 91 ft.

■ **Methods:**
- Core Spray (QCOP 1400-02)
- Group 1 and other Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **Cannot stay below the Primary Containment Pressure Limit (Fig D)!**

Control torus pressure below the Primary Containment Pressure Limit (Fig D) using either or both of the following methods:
- Vent the primary containment (QCOP 1800-13).
- Stop RPV and primary containment injection from outside the primary containment.

CONTAINMENT VENTING

■ **When:**
- As necessary to hold primary containment water level above 28 ft (4 ft above the drywell floor).
- To restore and hold torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1800-13.

RPV VENTING

■ **When:**
- Do not vent the RPV.

DRYWELL SPRAYS

Do not initiate sprays (vacuum breakers submerged).

TORUS SPRAYS

Spray function not available (spray nozzles submerged).

START

GENERAL INSTRUCTIONS

■ This procedure overrides all OGAs.
■ While in this procedure:
- ☛ OK to inhibit isolations and interlocks interfering with required actions
- ☛ OK to exceed release rate limits during primary containment and RPV venting.
- ☛ Check Detail A for limits on RPV water level indications

CAUTION: Exceeding NPSH/Vortex Limits may cause system damage.

❶ Has core debris breached the RPV?

Yes → ☛ RPV breached; pressure suppression no longer required.
☛ Cool debris in primary containment.

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Run drywell sprays at 2016 gpm or more.
2. Maximize RPV injection from outside primary containment.
3. Maximize direct primary containment injection from external sources.
4. Maximize RPV injection from the torus.

■ **Methods:**
- Drywell sprays (see below).
- Group 1 and Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **Approaching or above the Primary Containment Pressure Limit (Fig D):**
- Vent the primary containment (QCOP 1800-13) to control torus pressure below the Primary Containment Pressure Limit (Fig D).
- IF.....you cannot stay below the Primary Containment Pressure Limit (Fig D),
  AND.....you can hold total injection into RPV and drywell above the Maximum Debris Retention Injection Rate (Fig Z),
  THEN...stop RPV and primary containment injection from outside the primary containment except drywell sprays.

CONTAINMENT VENTING

■ **When:**
- As necessary to hold flood the containment.
- To control torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1800-13.

RPV VENTING

■ **When:**
- Do not vent the RPV.

DRYWELL SPRAYS

■ **When:**
- Core debris has breached the RPV.
  - ☛ Even if RPV or primary containment injection will be reduced.
  - ☛ Even if drywell temperature is above the Drywell Spray Initiation Limit (Fig K).
- As required by SAMG-2.

■ **Initiate only if:**
- No restrictions. Initiate even if drywell temperature is above the Drywell Spray Initiation Limit (Fig K).

■ **Operation (QCOP 1000-30):**
- Hold spray flow above 2016 gpm.
  - ☛ Even if RPV or primary containment injection will be reduced.
- Use external sources if possible.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- RPV injection will not be reduced;
  AND
- You can hold drywell spray flow above 2016 gpm (if drywell sprays are running);
  AND
- Torus water level is below 27 ft.

■ **Operation (QCOP 1000-30):**
- Use external sources if possible.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.
  - You cannot hold drywell spray flow above 2016 gpm with torus sprays running.

WAIT until primary containment water level reaches 28 ft (4 ft above drywell floor)

To ❷

❷ Can you restore and hold RPV water level above -142 in. (TAF)?

No or unknown → ☛ Reflood the RPV to submerge the core.
Yes →

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Restore and hold RPV water level between -142 in. (TAF) and 48 in.

■ **Methods:**
- Use only Group 1 systems (Detail E) if possible.
  - ☛ Use Group 2 systems (Detail E) only if necessary to restore and hold RPV water level above -142 in. (TAF).
  - ☛ Add water from outside primary containment only if necessary to restore and hold RPV water level above -142 in. (TAF).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **Approaching or above the Primary Containment Pressure Limit (Fig D):**
1. Stop direct injection into the primary containment from external sources.
2. IF.....you still cannot stay below the Primary Containment Pressure Limit (Fig D),
   THEN - Vent the primary containment (QCOP 1800-13) to control torus pressure below the Primary Containment Pressure Limit (Fig D).
   - IF.....you reach the Primary Containment Pressure Limit (Fig D),
     AND.....you can hold RPV water level above -142 in. (TAF),
     THEN...stop RPV injection from outside the primary containment except boron injection from SBLC.

CONTAINMENT VENTING

■ **When:**
- As necessary to restore and hold RPV water level above -142 in. (TAF).
- To control torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1800-13.

RPV VENTING

■ **When:**
- As necessary to restore and hold RPV water level above -142 in. (TAF).

■ **Methods:**
- See Detail F.

DRYWELL SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV water level above -142 in. (TAF).
  AND
- Drywell temperature is below the Drywell Spray Initiation Limit (Fig K).
  AND
- Torus water level is below 17 ft.

■ **Operation (QCOP 1000-30):**
- OK to use external sources.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.
  - You cannot hold RPV water level above -142 in. (TAF) with sprays running.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV water level above -142 in. (TAF).
  AND
- Torus water level is below 27 ft.

■ **Operation (QCOP 1000-30):**
- OK to use external sources.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.
  - You cannot hold RPV water level above -142 in. (TAF) with sprays running.

❸ Can you restore and hold RPV water level above -287 in. (BAF)?

No or unknown → ☛ Core debris is not expected to melt through RPV.
☛ Flood above TAF for long-term cooling.
Yes →

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Operate Core Spray.
2. Restore and hold RPV water level above -287 in. (BAF).
3. Maximize total RPV and primary containment injection from outside primary containment.

■ **Methods:**
- Core Spray (QCOP 1400-02)
  - ☛ Keep one suction lined up to torus if possible
  - ☛ Use CCST suction for other pump if possible
- Group 1 and other Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **RPV pressure more than 74 psi above torus pressure:**
- Stop direct injection into the primary containment from external sources.

■ **Approaching or above the Primary Containment Pressure Limit (Fig D):**
1. Stop direct injection into the primary containment from external sources except drywell sprays.
2. IF.....you still cannot stay below the Primary Containment Pressure Limit (Fig D),
   THEN - Vent the primary containment (QCOP 1800-13) to control torus pressure below the Primary Containment Pressure Limit (Fig D).
   - IF.....you reach the Primary Containment Pressure Limit (Fig D),
     AND.....you can hold RPV water level above -287 in. (BAF),
     THEN...stop RPV injection from outside the primary containment except boron injection from SBLC.

CONTAINMENT VENTING

■ **When:**
- As necessary to increase RPV injection.
- As necessary to help flood the containment.
- To control torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1800-13.

RPV VENTING

■ **When:**
- Primary containment water level is higher than RPV water level.

■ **Methods:**
- See Detail F.

DRYWELL SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV water level above -287 in. (BAF).
  AND
- Drywell temperature is below the Drywell Spray Initiation Limit (Fig K).
  AND
- Torus water level is below 17 ft.

■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.
  - You cannot hold RPV water level above -287 in. (BAF) with sprays running.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV water level above -287 in. (BAF).
  AND
- Torus water level is below 27 ft.

■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.
  - You cannot hold RPV water level above -287 in. (BAF) with sprays running.

❹ Can you restore and hold RPV injection above the Minimum Debris Retention Injection Rate (Fig Z)?

No or unknown → ☛ Core debris is not expected to melt through RPV.
☛ Flood above TAF for long-term cooling.
Yes →

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Operate Core Spray.
2. Control RPV injection above the Minimum Debris Retention Injection Rate (Fig Z).
3. Maximize total RPV and primary containment injection from outside primary containment.

■ **Methods:**
- Core Spray (QCOP 1400-02)
  - ☛ Keep one suction lined up to torus if possible
  - ☛ Use CCST suction for other pump if possible
- Group 1 and other Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **RPV pressure more than 74 psi above torus pressure:**
- Stop direct injection into the primary containment from external sources.

■ **Approaching or above the Primary Containment Pressure Limit (Fig D):**
1. Stop direct injection into the primary containment from external sources except drywell sprays.
2. IF.....you still cannot stay below the Primary Containment Pressure Limit (Fig D),
   THEN - Vent the primary containment (QCOP 1800-13) to control torus pressure below the Primary Containment Pressure Limit (Fig D).
   - IF.....you reach the Primary Containment Pressure Limit (Fig D),
     AND.....you can hold RPV injection above the Minimum Debris Retention Injection Rate (Fig Z),
     THEN...stop RPV injection from outside the primary containment except boron injection from SBLC.

CONTAINMENT VENTING

■ **When:**
- As necessary to increase RPV injection.
- As necessary to help flood the containment.
- To control torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1800-13.

RPV VENTING

■ **When:**
- Primary containment water level reaches 50 ft.

■ **Methods:**
- See Detail F.

DRYWELL SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV injection above the Minimum Debris Retention Injection Rate (Fig Z),
  AND
- Drywell temperature is below the Drywell Spray Initiation Limit (Fig K),
  AND
- Torus water level is below 17 ft.

■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.
  - You cannot hold RPV injection above Minimum Debris Retention Injection Rate (Fig Z) with sprays running.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- You can hold RPV injection above Minimum Debris Retention Injection Rate (Fig Z),
  AND
- Torus water level is below 27 ft.

■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.
  - You cannot hold RPV injection above Minimum Debris Retention Injection Rate (Fig Z) with sprays running.

❺ Inside the Pressure Suppression Pressure (Fig L)?

No → ☛ Core debris may melt through RPV.
☛ Maintain pressure suppression capability.
Yes or unknown →

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Hold torus water level below 17 ft.
2. Have water on drywell floor.
3. Restore RPV injection above Minimum Debris Retention Injection Rate (Fig Z).
4. Inject into the primary containment from external sources.

■ **Methods:**
- Group 1 and Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **RPV pressure more than 74 psi above torus pressure:**
- Stop direct injection into the primary containment from external sources.

■ **Cannot hold torus pressure below the Pressure Suppression Pressure (Fig L):**
- Vent the primary containment (QCOP 1600-13) to control torus pressure below the Pressure Suppression Pressure (Fig L).

■ **Cannot hold torus water level below 17 ft:**
1. Stop direct injection into the primary containment from external sources.
2. IF.....torus water level approaches 17 ft,
   THEN...stop RPV injection from outside the primary containment except boron injection from SBLC.

CONTAINMENT VENTING

■ **When:**
- As necessary to increase RPV injection.
- As necessary to help flood the containment.
- To control torus pressure below the Pressure Suppression Pressure (Fig L) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1600-13.

RPV VENTING

■ **When:**
- Do not vent RPV.

DRYWELL SPRAYS

■ **When:**
- As required by SAMG-2.
  - ☛ Even if RPV injection will be reduced.

■ **Initiate only if:**
- Drywell temperature is below the Drywell Spray Initiation Limit (Fig K).
  AND
- Torus water level is below 17 ft.

■ **Operation (QCOP 1000-30):**
- Operate sprays even if RPV injection will be reduced.
- OK to use external sources if:
  - RPV pressure is less than 74 psi above torus pressure.
  AND
  - You can hold torus water level below 17 ft.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.
  - ☛ Even if RPV injection will be reduced.

■ **Initiate only if:**
- Torus water level is below 27 ft.

■ **Operation (QCOP 1000-30):**
- Operate sprays even if RPV injection will be reduced.
- OK to use external sources if:
  - RPV pressure is less than 74 psi above torus pressure.
  AND
  - You can hold torus water level below 17 ft.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.

❻ Outside the Pressure Suppression Pressure (Fig L)?

No → ☛ Core debris may melt through RPV.
☛ Pressure suppression unavailable; containment may fail.
Yes →

RPV / CONTAINMENT INJECTION

✓ **PRIORITIES:**
1. Have water on drywell floor.
2. Maximize total RPV injection from all sources.
3. Maximize direct primary containment injection from external sources.

■ **Methods:**
- Group 1 and Group 2 systems (Detail E).

CONTAINMENT LEVEL/PRESSURE LIMITS

■ **RPV pressure more than 74 psi above torus pressure:**
- Stop direct injection into the primary containment from external sources.

■ **Approaching or above the Primary Containment Pressure Limit (Fig D):**
1. Vent the primary containment (QCOP 1600-13) to control torus pressure below the Primary Containment Pressure Limit (Fig D).
2. IF.....you still cannot stay below the Primary Containment Pressure Limit (Fig D),
   THEN...stop direct primary containment injection from external sources except drywell sprays.

CONTAINMENT VENTING

■ **When:**
- As necessary to increase RPV injection.
- As necessary to help flood the containment.
- To control torus pressure below the Primary Containment Pressure Limit (Fig D) (see Containment Level/Pressure Limits above).
- As required by SAMG-2.

■ **Methods:**
- See QCOP 1600-13.

RPV VENTING

■ **When:**
- Primary containment water level reaches 50 ft.

■ **Methods:**
- See Detail F.

DRYWELL SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- Drywell temperature is below the Drywell Spray Initiation Limit (Fig K).
  AND
- Torus water level is below 17 ft.,
  AND
- Either:
  - RPV injection will not be reduced,
    OR
  - RPV pressure is 74 psi or more above torus pressure,
    OR
  - Spray operation will restore and hold torus pressure inside the Pressure Suppression Pressure (Fig L).

■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop drywell sprays:
  - Before drywell pressure drops to 0 psig.
  - If RPV injection will be increased by stopping sprays and RPV pressure is less than 74 psi above torus pressure.

TORUS SPRAYS

■ **When:**
- As required by SAMG-2.

■ **Initiate only if:**
- Torus water level is below 27 ft.,
  AND
- Either:
  - RPV injection will not be reduced,
    OR
  - RPV pressure is 74 psi or more above torus pressure,
    OR
  - Spray operation will restore and hold torus pressure inside the Pressure Suppression Pressure (Fig L).

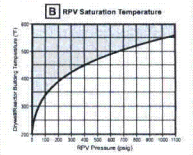
■ **Operation (QCOP 1000-30):**
- Use external sources if possible when:
  - RPV pressure is less than 74 psi above torus pressure.
- Stop torus sprays:
  - Before torus pressure drops to 0 psig.
  - If RPV injection will be increased by stopping sprays and RPV pressure is less than 74 psi above torus pressure.

A RPV Water Level Instruments

CAUTION: RPV water level instruments may be unreliable due to boiling in the instrument runs when drywell or reactor building temperature is above Fig B, RPV Saturation Temperature.

An RPV water level instrument may be used only if the criteria in Table C are satisfied.

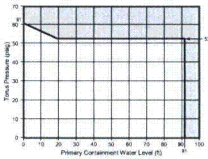
B RPV Saturation Temperature



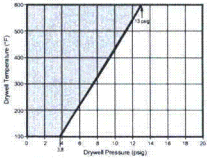
C RPV Level Instrument Criteria

Instrument	Range (in.)	Use only if...
Fuel Zone	340 to +90	Indicated level above -303 in.
Lower Wide Range	344 to +88	Indicated level above -301 in.
Medium Range	-60 to +60	Indicated level above -43 in. OR Reactor building temperature below 185°F
Upper Wide Range	-42 to +358	Indicated level above 73 in.
Narrow Range	0 to +60	Indicated level on scale

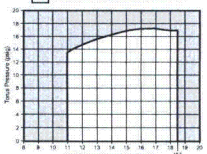
D Primary Containment Pressure Limit



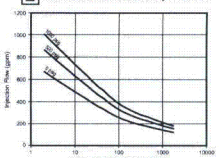
K Drywell Spray Initiation Limit



L Pressure Suppression Pressure



Z Minimum Debris Retention Injection Rate



Quad Cities Nuclear Power Station Units 1(2)
SEVERE ACCIDENT MANAGEMENT GUIDELINE

Title: PRIMARY CONTAINMENT FLOODING

Number: SAMG-1 | Revision 2 February 2002

B12