POST-ACCIDENT SAMPLING SYSTEM
CAPABILITIES AND DESCRIPTION

SAN ONOFRE NUCLEAR GENERATING STATION
UNIT 1

July, 1980

Scope

Post-Accident Sampling System modifications are planned at San Onofre Unit 1 to satisfy the requirements of NUREG-0578, Section 2.1.8.a, as clarified by the NRC letter dated October 30, 1979. The primary purpose of implementing Post-Accident Sampling System capabilities is to improve efforts to assess and control the course of an accident. The system will provide information related to the extent of core damage that has occurred or may be occuring during an accident, to determine the types and quantities of fission products released to the containment in the liquid and gas phase and which may be released to the environment and to provide information on coolant chemistry (i.e., dissolved gas, boron and pH) and containment hydrogen.

Design Criteria

The Post-Accident Sampling System will provide the capability to remotely collect the reactor coolant, containment sump liquid and containment atmosphere samples within one hour under accident conditions. The system will provide remote readout of the results of chemical and radiological analyses and return radioactive samples inside containment. The design criteria for the Post-Accident Sampling System are as follows:

1. Quantification of the following within one hour of obtaining pressurized and unpressurized reactor coolant, containment sump liquid and containment atmosphere samples:

   a. isotopes that are indicators of core damage (i.e., noble gases, iodines, cesiums, and non-volatile isotopes), and

   b. dissolved gases (i.e., H_2, O_2), boron, and pH of the reactor coolant.

2. Remote override of the Containment Isolation Actuation Signal (CIAS) to reactor coolant, containment sump liquid and containment atmosphere sample line isolation valves will exist post-accident to ensure that the samples can be collected within one hour.

3. Post-accident sampling and analyses will not result in personnel radiation exposure in excess of 3 and 18 3/4 Rem to the whole body and extremities, respectively.

4. The system will be capable of accommodating an initial reactor coolant radiochemical spectrum corresponding to a Regulatory Guide 1.4, Rev. 2, release.

5. All post-accident sample purge flow will be returned to the containment to minimize contamination of other auxiliary systems and to ensure that high level waste remains isolated within the containment.

6. Containment atmosphere sampling will be possible under both positive and negative containment pressures.

7. A reactor coolant sample will be drawn from the reactor coolant system and a containment liquid sample will be drawn from the containment sump.

8. Samples will be cooled and diluted, as required, to facilitate measurement.

9. Onsite multichannel analyzer equipment will be used for isotopic analysis of the reactor coolant, containment sump liquid and containment atmosphere samples.

10. Downstream of the containment isolation valves, components and piping will be non-safety related, non-1E, non-Category A, and non-code (ASME B&PV Code, Section III).

11. Total dissolved gas concentrations up to approximately 2000 cc/kg will be measured.

12. Design parameters for the system are based on a reactor coolant design pressure and temperature of 2485 psig and 650°F and a containment atmosphere pressure and temperature of 65 psig and 300°F.

13. Hydrogen monitors located inside containment will provide continuous indication.

14. Diluted grab samples will be taken for further analysis (e.g., chlorides) on or offsite, as required.

Sample Analysis Capabilities

All required measurements, excepting chloride analysis, will be performed with on-line meters and detectors. Onsite laboratory chloride analysis will be performed within one shift as required in NUREG-0578. The sensitivity of onsite post-accident analyses will permit measurement of nuclide concentrations from approximately 1 μCi/gm to Regulatory Guide 1.4 levels. Hydrogen monitors located in containment, will be installed to provide continuous indication as required by NUREG-0578.

A preliminary piping and instrument diagram showing the Post-Accident Sampling System is attached as Figure 1. The system influent equipment design parameters are as follows:

	Reactor Coolant	Containment Atm
Pressure	atm -2485 psig	-2 in. Hg - 60 psig
Temp	50-650°F	50-300°F
H^2	$\leq 2000 \frac{CC(STP)}{Kg}$	0-10 Volume%
O_2	Saturated @ atm	-

	Reactor Coolant	Containment Atm
Boron	100-4400 ppm	-
pH	3-12	-
Cl^-	0-2 ppm	-
Radio Chemistry		
Nuclides (gross γ)	$<10^7$ μ Ci/cc	$< 10^5$ μ Ci/cc
Sample line Dose Rate	5×10^4 R/hr	1×10^4 R/hr
Dissolved Solids	5-20 ppm	-
Iodine (I-131)	2.6×10^4 μCi/cc	3.5×10^2 μCi/cc
Noble Gas (Kr-85)	4.3×10^2 μCi/cc	10 μCi/cc
(Xe-133)	1×10^5 μ Ci/cc	2.8×10^3 μCi/cc

System Description

A shielded underground sample station will be constructed to house the Post-Accident Sample System. The underground arrangement will minimize personnel exposure and preserve space for normal station activities. Inside the sample station, a concrete shield wall will separate the control area from the sample process area. A preliminary site location plan showing the general arrangement of the Post-Accident Sampling System is attached as Figure 2.

A completely enclosed stairwell provides personnel access to the control area. Enclosure of the stairwell is necessary to prevent the influx of drainage water and the associated moisture problems. A removable roof panel above the control area will allow entry for large equipment (e.g., control panel).

Access to the sample process area for equipment installation and periodic maintenance is through a removable roof panel. The roof panel will be several feet thick requiring the use of heavy equipment for removal. The roof panel geometry will prevent leakage into the sample process area.

Environmental conditions in the underground station will be monitored and maintained as required. The sample process area will be maintained under slight negative pressure to assure that any air leakage is into the process area. A ventilation system will be included to control airborne radioactivity. The control area temperature and relatiave humidity will be monitored for the protection of electronic equipment (e.g., control panel and amplifier). High range portable survey instruments and personnel dosimeters will be provided to permit rapid assessment of high exposure rates and accumulated personnel exposure.

Interconnecting piping required for radioactive sample delivery and return will be routed from the containment isolation valves inside the Sphere Enclosure Building above grade and from the Sphere Enclosure Building to the sample process area in a shielded underground trench as shown on Figure 2. Drainage of the trench will be into the process area sump in the underground station. Removable panels will cover the trench and permit the future placement of additional piping as required. The underground trench and sample station have been located to minimize the length of inlet piping required. Long inlet piping runs pose shielding problems and promote particle plate out.

All sampling operations will be activated, monitored, and controlled remotely from the control panel located in the control area of the underground sample station. Pressure, temperature, and flow readout will be located on the control panel. Throttling and isolation valves to control the sample flow process will be provided with pneumatic operators and controlled remotely at the control panel. Manually operated reach rods extending through the shield wall will provide redundant operational capability.

Liquid and atmospheric samples will be collected and analyzed in the process area of the underground station. Major hardware items including valves, collection vessels, tanks, and pumps will be housed in a 6' x 4' x 6' high cabinet. The cabinet will be bolted to the floor and configured for ease of maintenance.

Two lead shielded germanium crystal gamma detectors, one for reactor coolant and containment sump liquid and one for containment atmosphere, will adjoin the shield wall on the control side of the sample station. Location of the detectors in the control area of the underground station is required to minimize background radiation levels and facilitate weekly liquid nitrogen filling. The spectrum results detected by the germanium detectors will be fed to a multichannel analyzer for analysis and readout.

Station procedures will be developed that identify the analyses required, measurement techniques and safety precautions. These procedures will be implemented prior to placing the Post-Accident Sampling System into service.