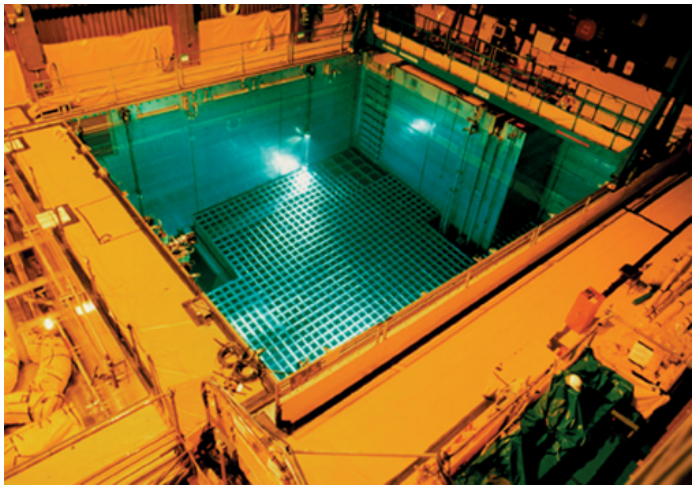
SPENT FUEL POOL DRAINED

Part of the RASCAL Instructor-led Training

SPENT FUEL - BACKGROUND

- A “cold gap release” occurs when spent fuel elements are mechanically damaged but the temperature is low enough that the cladding does not suffer any thermal damage. Radionuclides in the gap between the cladding and the fuel pellets will be released.
- A “hot gap release” occurs when the fuel cladding ruptures due to heat build up releasing the gap inventory. If the spent fuel elements in a pool become uncovered, their temperature will rise. If the temperature reaches 1200 °F, the fuel cladding will rupture due to the buildup up of internal pressure and will release the radioactivity in the gap between the cladding and the fuel pellets.
- A “cladding fire release” occurs when the fuel elements remain uncooled and the temperature becomes high enough to cause the cladding to burn.

RASCAL CAN MODEL 3 TYPES OF SPENT FUEL ACCIDENTS.



1. Spent fuel pool drained
   -Hot gap -> Cladding Fire
2. Fuel assembly damaged underwater
   -Cold gap

3. Damage to fuel stored in dry casks
   -Cold gap

Spent Fuel - Scenario

The Diablo Canyon, Unit 2, power plant has experienced a loss of water level in the spent fuel pool due to an earthquake.

The licensee reports it is the result of a large crack in the pool and postulates that the water is possibly flowing into a sink hole.

Due to a malfunctioning pump, the operators have not been able to make up for the loss of water in the spent fuel pool.

SPENT FUEL - SCENARIO

The water level in the pool dropped to the top of the fuel at 08:50, and will likely to continue to drop. Estimates are that the fuel will be fully uncovered by 11:00 and the licensee is attempting to recover the fuel or provide alternate cooling methods.

In technical consultation with the licensee and based upon the age of the fuel in the pool it is estimated that the hottest assemblies experience a gap release (a precursor to a potential zirconium fire) in approximately 22 hours.

Spent Fuel - Scenario

The licensee also reports that the pool currently contains three batches of fuel (a batch is defined as one-third of a core): one of which was from the most recent refueling 360 days ago, and 2 from previous refuelings. The licensee anticipates being able to be able to recover the fuel or provide alternate spray flow cooling within 24 hours.

The building has been severely damaged and is in many places directly open to the atmosphere. Assume the release point to be unfiltered, 10 meters above ground and use *Standard Meteorology*.

Spent Fuel – Task

- Do an assessment and record the source term and dose information in the tables.

	Activity (Ci)	Percent of Total (%)
Noble gas		
Iodines		
Other		
Total		

Dose	Distance from the Release		
	1 Mile	5 Miles	10 Miles
TEDE (rem)			
Adult Thyroid CDE (rem)			

- To what distances are the EPA PAGs exceeded for TEDE and Adult Thyroid CDE?
- If the date of the last refueling changed to 30 days vice the 360 days entered above, how does that change the distances that the change the distance at which the EPA PAGs are exceeded for TEDE and Adult Thyroid CDE? If so why?

Spent Fuel - Results

	Activity (Ci)	Percent of Total (%)
Noble gas	8.7E4	13
Iodines	5.0E-8	0
Other	5.8E5	87
Total	6.7E5	100

Dose	Distance from the Release		
	1 Mile	5 Miles	10 Miles
TEDE (rem)	25	6.2	3.1
Adult Thyroid CDE (rem)	16	4	2

- EPA PAGs exceeded +10 mi (TEDE), 3 mi (Thyroid)
- Conclusions?
  - Model always assumes fire
  - Likelihood of event?