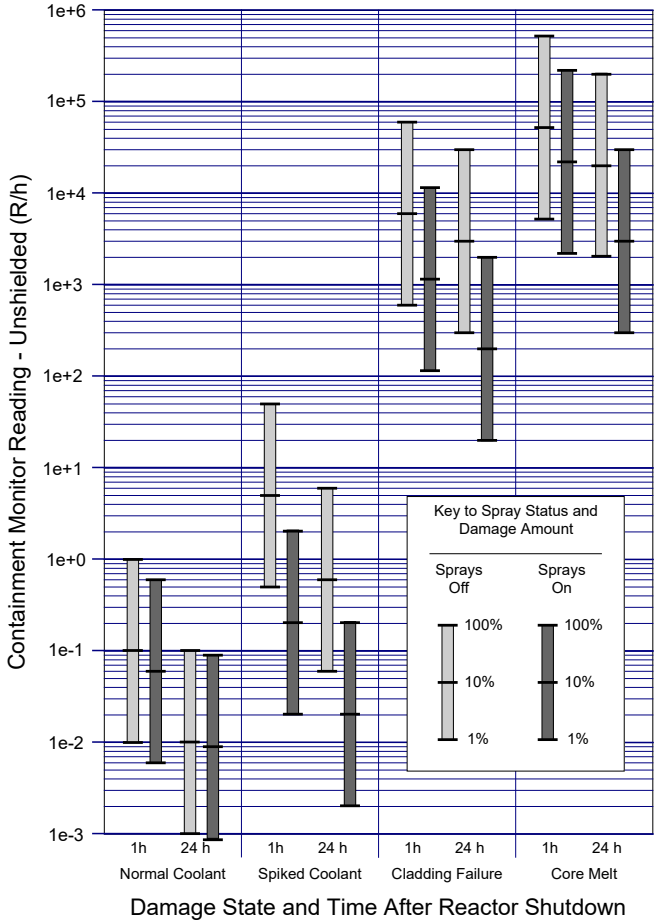
Containment Radiation Monitor Readings

Part of the RASCAL Instructor-led Training

Containment Rad Monitor - Background

- One or more instruments inside containment used to continuously survey the containment volume for radiation.
- Generally reads out in units of R/h.
- Readings will be shown in the control room and will likely be available from plant data systems.

THE CONTAINMENT RADIATION MONITOR SOURCE TERM METHOD ESTIMATES CORE DAMAGE STATES FROM EACH MONITOR READING.

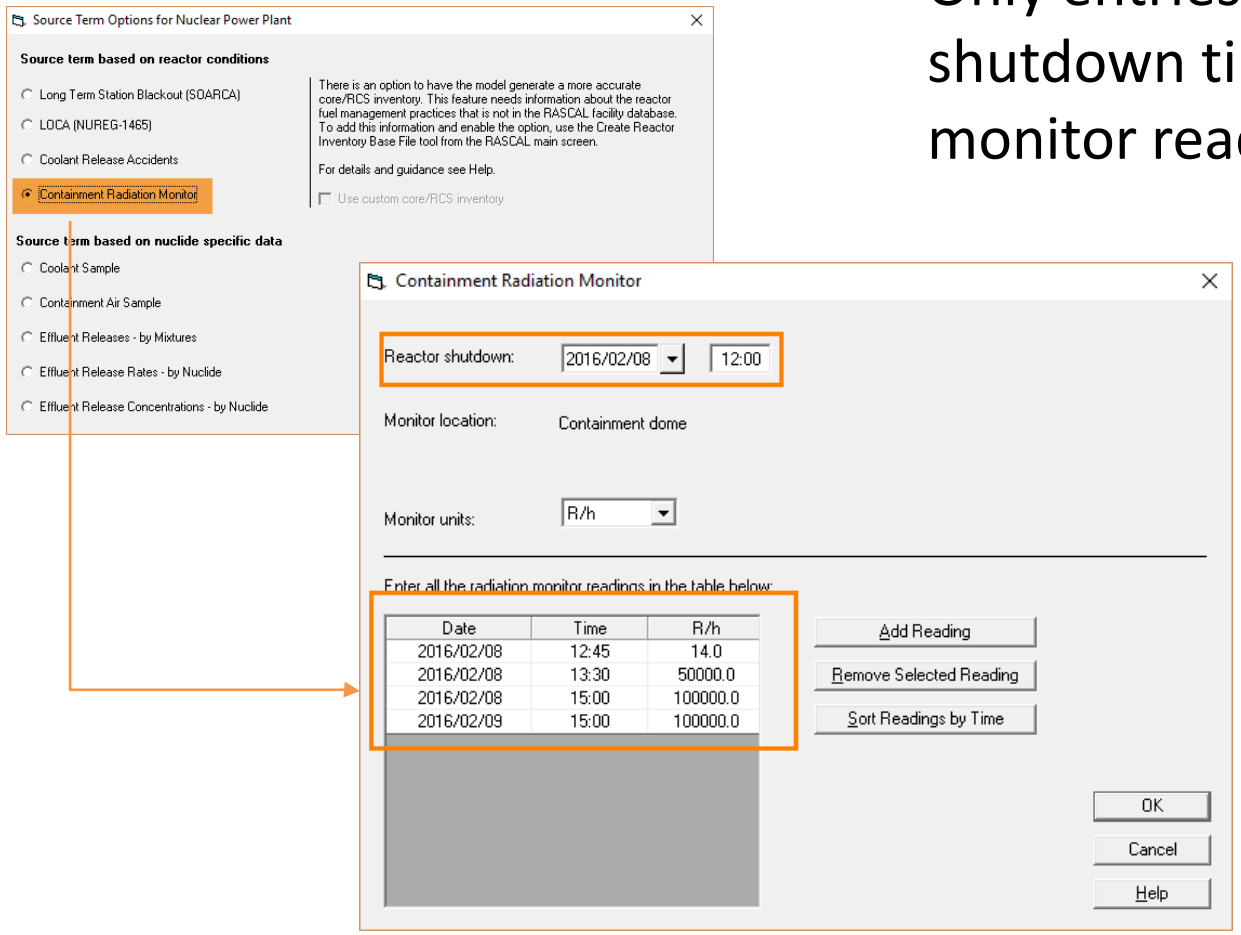


The model uses tables such as this one to convert the reading into a damage amount.

Two factors in addition to the R/h reading are considered:

Time since reactor shutdown, and whether sprays are on or off.

CONTAINMENT RADIATION MONITOR IS ONE OF THE SOURCE TERM OPTIONS BASED ON REACTOR CONDITIONS.



Only entries required are the shutdown time and the actual rad monitor readings.

Containment Rad Monitor - Scenario

A malfunction occurred at the Shearon Harris Nuclear Power Plant causing the plant to shutdown (reactor scram) at 12:00. Approximately 45 minutes later it was determined by the operators that the core was uncovered.

Containment Rad Monitor - Scenario

During the course of the event, the operators in the control room receive periodic readings from the containment dome radiation monitor.

Time	Containment Radiation Monitor Reading (R/h)
12:45	14
13:30	50,000
15:00	100,000
+1 day, 15:00	100,000

The release from the core passed into the containment building and the containment sprays are not operating. The operators determined that the containment remained intact and the release from the containment was via design leakage rate.

Containment Rad Monitor - Task

Using the RASCAL *Predefined Data (Non Site-specific)* option with the *Standard Meteorology* dataset, do an assessment. At the end, consult the case summary report to see how much core damage RASCAL estimated for each reading

Time	Containment Radiation Monitor Reading (R/h)	RASCAL Calculated Core Damage
12:45	14	
13:30	50,000	
15:00	100,000	
+1 day, 15:00	100,000	

YOUR TURN TO USE RASCAL

- **Given the scenario excerpt below, run the entire case in RASCAL.**

Shearon Harris NPP shut down (reactor scram) at 12:00. The release from the core passed into the containment building and the containment sprays are not operating. Containment remained intact and the release from the containment was via design leak rate.

Using the Predefined Data (Non Site-specific) option with the Standard Meteorology dataset, do an assessment. At the end, consult the case summary report to see how much core damage RASCAL estimated for each reading.

Time	Containment Radiation Monitor Reading (R/h)	RASCAL Calculated Core Damage
12:45	14	
13:30	50,000	
15:00	100,000	
+1 day, 15:00	100,000	

LET'S WALK THROUGH THE PROBLEM TOGETHER

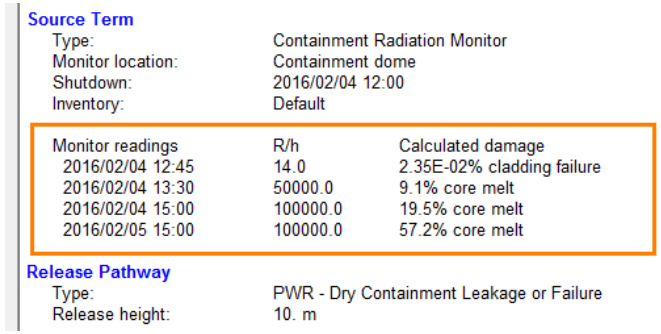
KNOWLEDGE CHECK

The 14 R/h reading translates into how much core damage?

- Effectively no damage
- Lots of clad failure
- A little core melt
- Lots of core melt

CONTAINMENT RAD MONITOR - RESULTS

From the case summary, we can see the calculated core damage:



Source Term

Type:	Containment Radiation Monitor
Monitor location:	Containment dome
Shutdown:	2016/02/04 12:00
Inventory:	Default

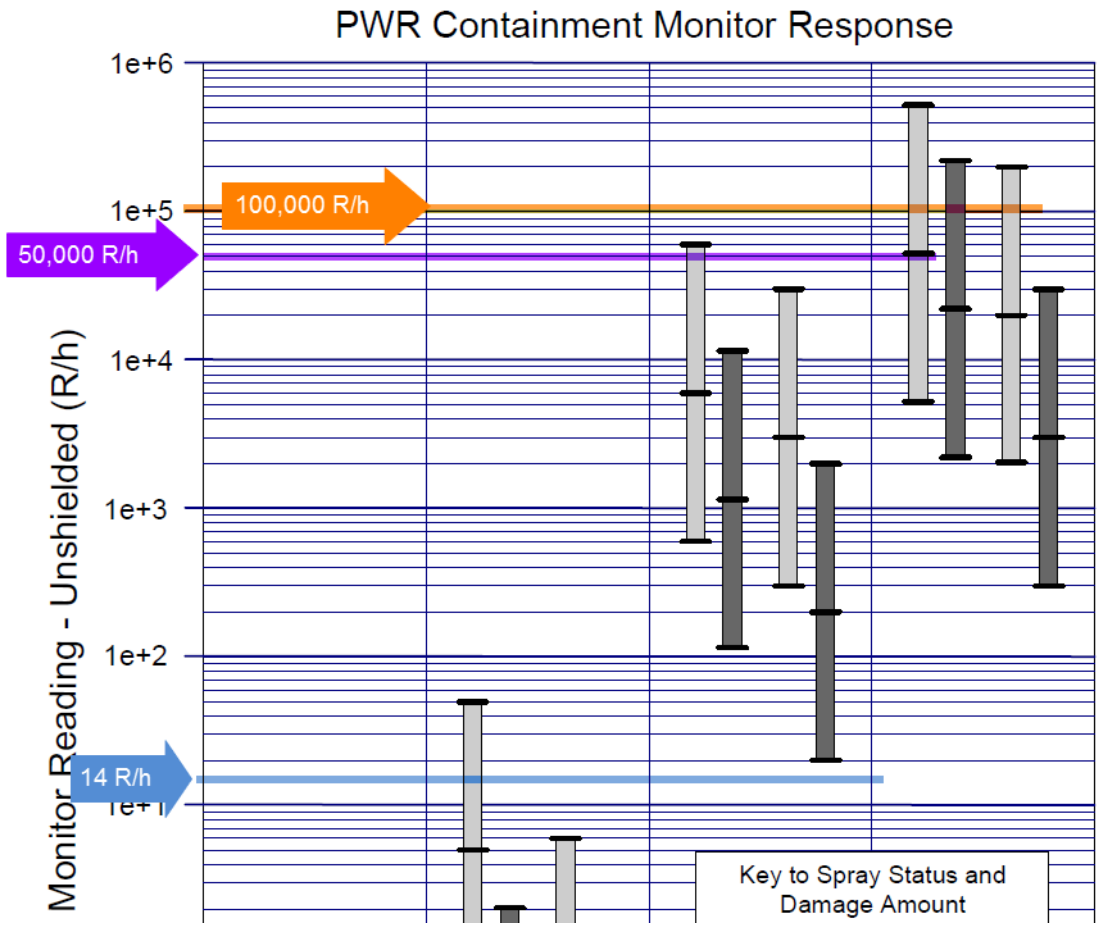
Monitor readings	R/h	Calculated damage
2016/02/04 12:45	14.0	2.35E-02% cladding failure
2016/02/04 13:30	50000.0	9.1% core melt
2016/02/04 15:00	100000.0	19.5% core melt
2016/02/05 15:00	100000.0	57.2% core melt

Release Pathway

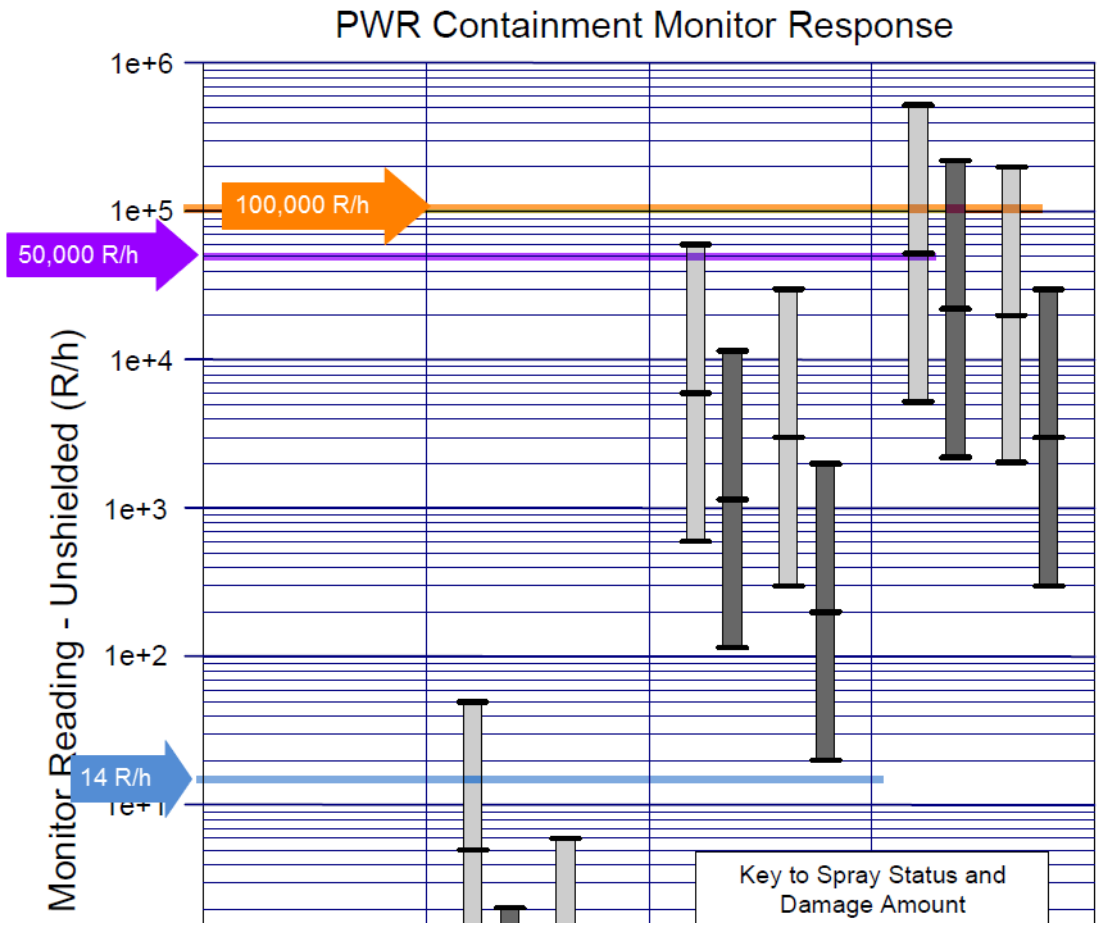
Type:	PWR - Dry Containment Leakage or Failure
Release height:	10. m

Time	Containment Radiation Monitor Reading (R/h)	RASCAL Calculated Core Damage
12:45	14	2.35E-02% cladding failure
13:30	50,000	9.1% core melt
15:00	100,000	19.5% core melt
+1 day, 15:00	100,000	57.2% core melt

We can see that the damage reported in RASCAL for each reading matches the table.



WHY DOES THE READING OF 100K R/H ON THE SECOND DAY GIVE A LARGER DAMAGE AMOUNT?



As detailed in NUREG-1940, these calculations have large uncertainties and certain limitations.

- Assumes that the readings represent the full amount of damage; may lag significantly or the release may bypass the containment
- Assumes uniform mixing of fission products in the containment atmosphere
- Assumes that the monitors are unshielded and see a large fraction of the containment volume
- Most appropriate for large-break LOCA
- Containment rad monitor is a lagging indicator of damage
- Method has no predictive capability

IN SUMMARY:

- If possible, this should not be your first choice for modeling a severe accident.
- However, it can be a good secondary, confirmatory calculation complementing the other predictive models.
- If you have containment monitor readings, it may provide some indication of the possible extent of core damage.