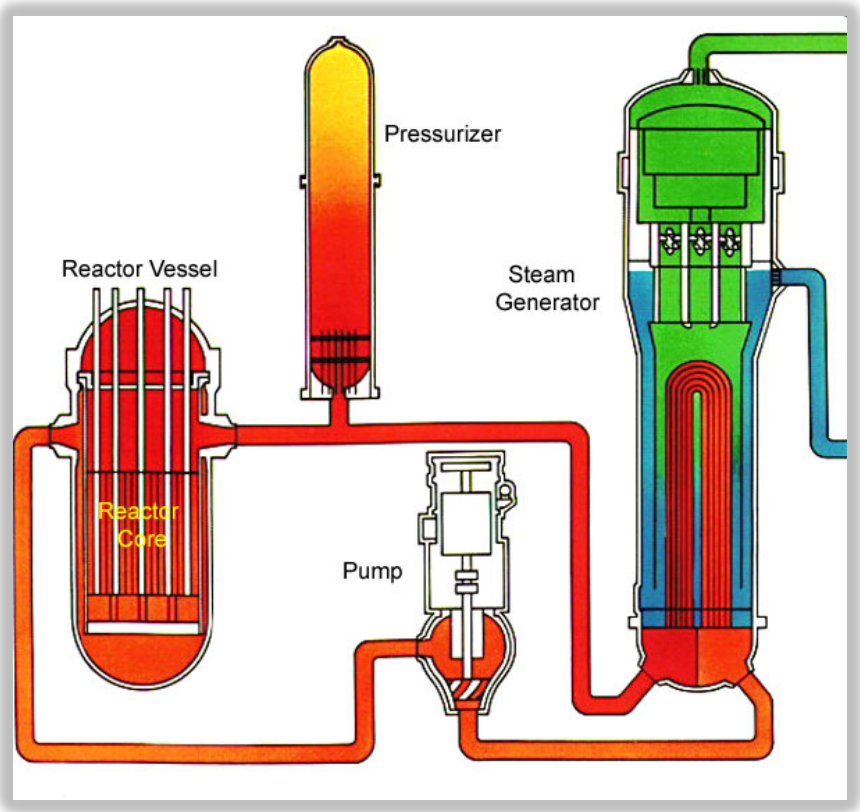
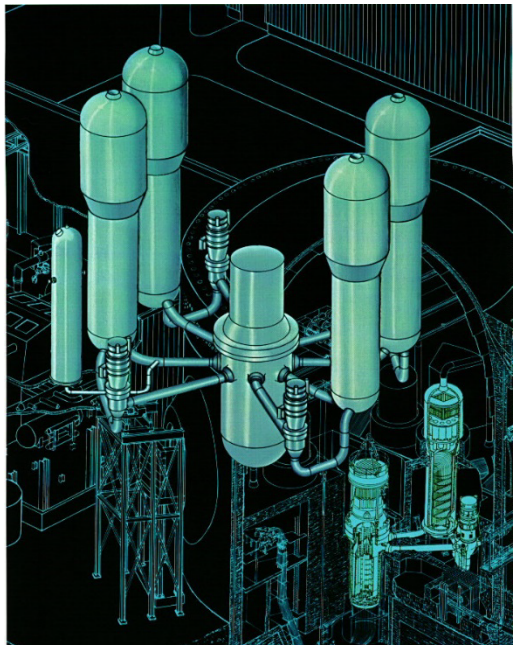
Steam Generator Tube Rupture

Part of the RASCAL Instructor-led Training

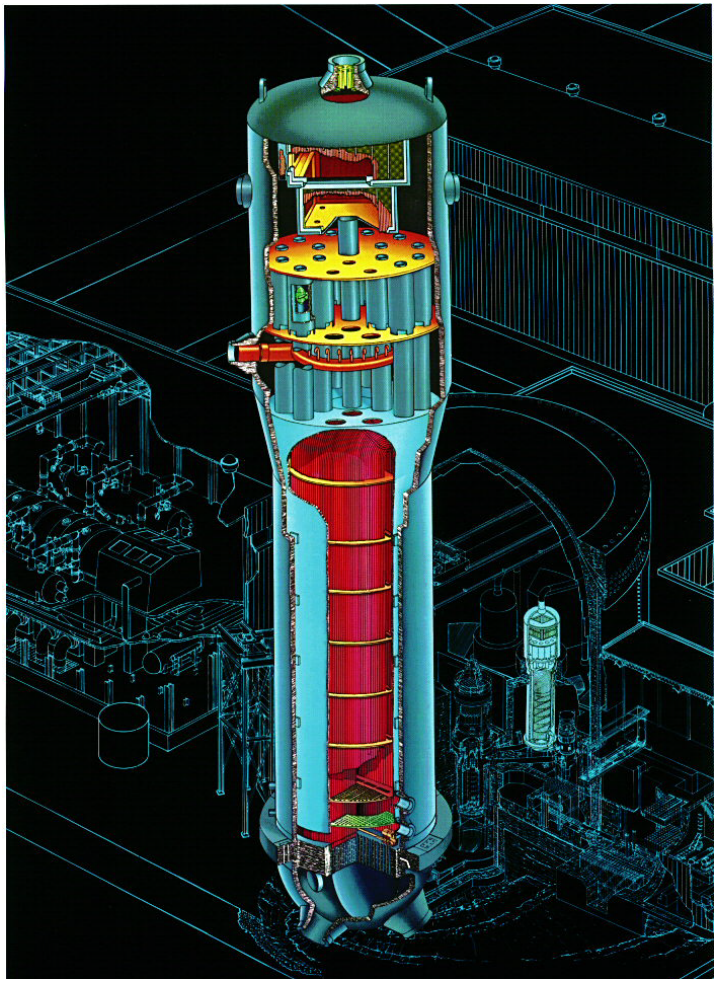
The steam generator in the PWR is the site of heat exchange between the primary side (core) and the secondary side (turbines).



There are usually 2 or 4 steam generators in PWRs.



There are two steam generator types: U-tube and once-through.

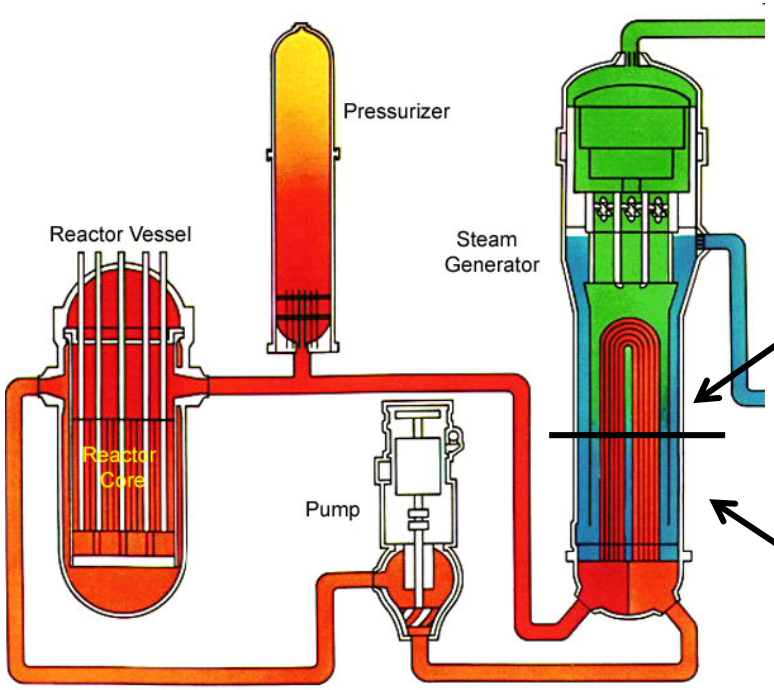


Each steam generator contains 3,000 – 16,000 tubes; each about 0.75 inches in diameter.

How does RASCAL Model a Steam Generator Tube Rupture?

- RASCAL treats it as a release pathway; in reality it is also an initiating event
- Describe the things the user must enter
  - Show screenshot of the release path event types
  - Break relative to water level
  - Steaming rate, Makeup flow rate, release point
  - How will the user know this information and is it important (model sensitive)

A STEAM GENERATOR TUBE RUPTURE (SGTR) ALLOWS PRIMARY SYSTEM COOLANT TO ESCAPE RAPIDLY INTO THE SECONDARY SYSTEM.



Leak above the water – most nuclides available for release; 50% of non-nobles escape.

Leak below the water – nuclides scrubbed and unavailable for release; 2% of non-nobles escape.

THE SGTR LEAK RATE IS DETERMINED BY THE RATE OF PRIMARY COOLANT LOSS AND LOSS OF STEAM FROM THE GENERATOR.

Estimate the primary coolant loss from the makeup flow rate.

Leave steaming rate at default unless better information is available.

SGTR RELEASES CAN BE THROUGH SAFETY RELIEF VALVES OR THE CONDENSER OFF-GAS EXHAUST.

Safety relief valve is an unfiltered pathway.

Condenser off-gas exhaust – only 5% of non-noble gases released.

ASPECTS OF COOLANT RELEASES IN RASCAL

- Database has information about nuclides that would be in normal coolant
- Discuss the concept of spiking
  - What is it
  - What does STDose do with it
  - Less likely now; fuel quality has improved

Steam Generator Tube Rupture - Scenario

The St. Lucie, Unit 1, Nuclear Power Plant experienced a sudden drop in primary system pressure and a sudden rise in secondary pressure at 00:36. The resulting drop in primary system pressure caused the reactor to automatically shutdown at the same time.

Steam Generator Tube Rupture - Scenario

The control room operators assume that a steam generator tube rupture (SGTR) had occurred and estimate that the makeup flow (including safety injection) to be about 500 gpm.

The increase in steam generator pressure caused the high-pressure safety relief valves to open briefly, but subsequently the increased steam generator pressure is released through the condenser off-gas exhaust.

Steam Generator Tube Rupture - Scenario

The control room operators have indications to assume that the SGTR break is above the water line (worst case) and that the steaming rate is at the default value.

The operators estimate that the sudden drop in primary system pressure will cause coolant spiking and assume a reactor coolant activity *spiking factor* of 30.

The release point is 30 meters above ground.

Steam Generator Tube Rupture - Task

Do an assessment using for meteorology the *Predefined Data (Non Site-specific)* option with the *Standard Meteorology* dataset.

Determine the projected TEDE and Adult Thyroid CDE at 0.5 miles and record the answers.

	Dose at 0.5 miles from the site
TEDE (rem)	
Adult Thyroid CDE (rem)	

Steam Generator Tube Rupture - Results

- Doses are low – coolant release; no core damage
- Generally the SG is isolated and any release is very small

	Dose at 0.5 miles from the site
TEDE (rem)	1.3E-03
Adult Thyroid CDE (rem)	5.7E-03