Regulatory Engagement Meeting- June 22,2026

FUNCTIONAL Containment for ARC-100 Facility

Framework and Performance Criteria

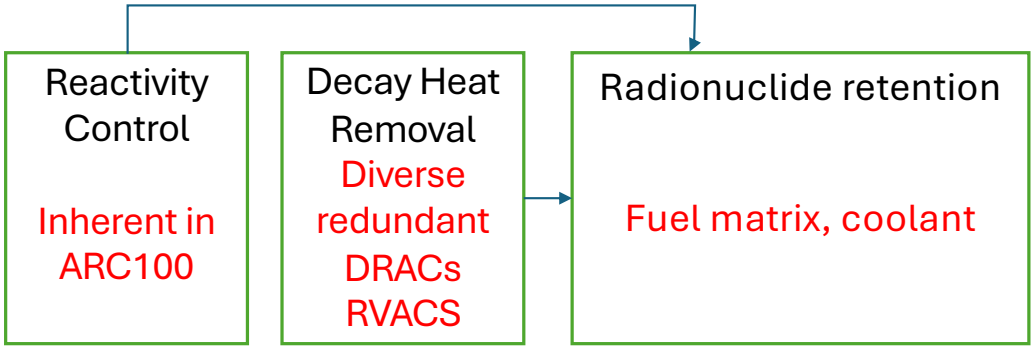
Functional Containment Framework

- The framework is to establish performance criteria for plant features involved in events established as part of the licensing basis events and the categorization of those events as anticipated (AOOs), unlikely (DBEs), very unlikely (BDBEs), Design Basis Accidents (DBAs) and extremely unlikely (cliff edge effects), that:
  - Have a role in mitigating the release of radioactive material
  - Plant feature need not be buildings but could be structures, (i.e. shielding) that reduce the radioactive content of materials released to the environment
- Each event and event sequence can in fact use different feature of the facility to b parts of the functional containment for that event and the performance criteria will depend on the event classification .

Risk Informed Acceptance Criteria

Adapted from SECY-18-0096

Note 1 Criteria :Acceptance is release rate and dose; Performance is SSC's specific parameters that must be met to achieve the acceptance criteria



Functional Containment
Normal Operation
Anticipated Events
DBE (Unlikely Events)
Design Basis Accidents (DBA)
BDBE (Very Unlikely Events)
Severe Accident(Extremely Unlikely Events)

Performance (Acceptance) Criteria Note 1
10CFR 20
Fuel design limits
Fuel design limits or F/C
10CFR53.210 (10CFR50.34)
BDBE (Very Unlikely Events)
Frequency/consequence targets , Safey Goal, EPA PAGs

Functional containment as needed for specific events
Reactor building
Reactor vessel/guard vessel and top enclosure
Reactor building compartments
External structure (e.g. DRACS missile shields, seismic isolators)
Internal structures (e.g. radiation shielding to reduce activation of fluids, guard pipes)
Coolant and cover gas clean systems
Reactor Building Exhaust filtration system

Functional Containments Details (1/3)

The performance of the ARC100 functional Containment is facilitated by

- The fuel matrix and cladding that have been shown during normal operations and anticipated occurrences (and also DBEs, DBAs, and most BDBEs) to retain radionuclides with a relatively low inventory released to the low pressure coolant (design basis of 21- pins out of a total of 21,483 or 0.1% pins).
- The behavior of the reactor to maintain temperatures that provide large margins to failure of the cladding by inherently reaching a controlled, stable (but still critical) state at what power the facility is producing is key to ensuring that the percentage of cladding that might fail is limited to the 0.1%. If only the two diverse passive heat removal systems (DRACs and RVACS) are available, then the controlled state will be at decay heat.
- The coolant affinity for some of the released radionuclides (e.g. iodine) further reduces the amount that are released to the cover gas .

For core originated releases, the path of the release to the environment is from the fuel matrix through cladding ,the coolant , to the cover gas, to leaks from cover gas or coolant leakages to the reactor building , which functions as the last barrier of the functional containment ,and also functions to protect risk-significant SSCs from internal and external events. (Slides 7-10 provide several examples)

Functional Containments Details (2/3)

The vast majority of the radioactive material that can be released to the environment is located in systems and components housed within the reactor building, and for events that involve those systems/components, the reactor building function as the last barrier of, or is the functional containment, and is designed as a low leakage building that can be tested to not leak above1.0 vol%/day.

However there are sources of radioactive material that are located outside the reactor building and for those components, depending on the specific event sequences, the reactor building may not be part of the functional containment.

- Liquid and gaseous wastes located in the Radwaste Building
- DRACS natural draft air heat exchanges are located outdoors on the lower roof of the reactor building ; are supported by the seismically isolated RB (and if necessary, can be further locally seismically isolated); and are protected by missiles shields anchored to the RB.
    - In the sense that the RB supports this safety related system , and protects the DRACS portions inside the RB, it does become part of the Functional Containment.
- However, from the standpoint or protecting onsite workers from radiation or minimize releases in case of leakage (of NaK) and possibly consequent fires, the actual radiation shielding placed around the DRACS submerged heat exchangers, which “functions” to minimize the activation of the NaK to a level that does not challenge the acceptance limits

Functional Containments Details (3/3)

- The RVACS is located within the reactor building, which support it and protects it. However, since the RVACS is a once-through safety related system, drawing in outside air to cool the guard vessel and releasing it to the environment via the chimney effect, the reactor building does not provide a barrier to the air released, and the argon in the air is activated. Therefore, the "function" to maintain the activation of the air below the permissible level is performed by radiation shielding of the core barrel, inlet plenum and in vessel stored fuel
- A third safety significant system that has components and parts inside and outside the reactor building is the intermediate heat transport system.
  - The IHTS equipment and piping act as the only functional containment
  - The radioactivity of the secondary sodium is minimized by providing radiation shields around the intermediate heat exchanger designed to reduce its activation to an acceptable level in case of leaks to the environment, and by maintaining the pressure in the intermediate system well above that of the primary system, so tube breaches would leak secondary sodium into the primary system
  - For the portions inside the reactor building, the process piping is protected by a guard pipe which is part of the functional containment and then by the reactor building itself.
  - The outside portions are not within a guard pipe, nor the reactor building , and **in the present design do not have any additional functional containment** because an event in that portion of the system has been evaluated as posing no risk the public, and to the integrity of the fuel cladding.

List of LBE considered for Functional Containment (1/4)

Operation or Transient Category	LBE	Fuel Matrix	Fuel Cladding	Primary Coolant	Coolant Processing	Guard Pipe/Dump Tank	Coolant Processing Compartment	Cover Gas	Cover Gas Processing	Cover gas Processing Compartment	Fire Suppression Deck	Shields to reduce activation	Reactor Top Closure Seals	Reactor Building Isolation	Reactor Building Clean up	Comments
Normal	RVACS Ar-41 Release	—	—	—	—		—	—	—	—		X	—	—	—	
AOO	Ar41 ,Na24,Na22							X	X				X	X	X	
AOO	Stochastic Pin Failures	X	—	X	X		—	X	X	—		—	X	X	X	
AOO	Stochastic Pin Failures w/o coolant or cover gas processing	X	—	X	—		—	X	—	—		—	—	—	—	
DBE	Cover Gas Line Break	X	Y	X	X		—	—	X	Y		—	—	—	—	99.9% implies operation with 0.1% failed pins
DBE	Cover gas Break with no coolant or cover gas processing	X	Y	X	—		—	—	—	Y		—	—	X	X	
DBE	Leaks or break in primary sodium processing system	X	Y	X			X							X	X	
DBA	Fuel assembly drop in vessel or in loading station		Z	X	X			X	X				X	X	X	Z implies accident damages Z % (19 pins of cladding
DBA	Fuel assembly stuck in FUM Transfer	X	X					X	X					X	X	

Y- implies operation with 0.1% failed pin; Z - implies accident damages Z % (19 pins of cladding)

List of LBE considered for Functional Containment (2/4)

Operation or Transient Category	LBE	Fuel Matrix	Fuel Cladding	Primary Coolant	Coolant Processing	Guard Pipe/Dump Tank	Coolant Processing Compartment	Cover Gas	Cover Gas Processing	Cover gas Processing Compartment	Fire Suppression Deck	Shields to reduce activation	Reactor Top Closure Seals	Reactor Building Isolation	Reactor Building Clean up	Comments
DBA	Fuel assmbly dropped in Wash station	X	Z					X	X					X	X	
DBA	Fuel assembly dropped in transfer to transportation /storage cask	X	Z											X	X	Based on 0.31 rem per failed pin calculated on the basis that the release occurs inside the reactor building leaking at 1vol%/day, the fuel handling accident appears to be the limiting accident, and requires a design that always transfers fuel inside the reactor building, and the ability of the reactor building under a severe earthquake to maintain it functional containment barrier function and subject the assembly to an impact causing at most 19 pin to fail.

Z - implies accident damages Z % (19 pins of cladding)

List of LBE considered for Functional Containment (3/4)

Operation or Transient Category	LBE	Fuel Matrix	Fuel Cladding	Primary Coolant	Coolant Processing	Guard Pipe/Dump Tank	Coolant Processing Compartment	Cover Gas	Cover Gas Processing	Cover gas Processing Compartment	Fire Suppression Deck	Shields to reduce activation	Reactor Top Closure Seals	Reactor Building Isolation	Reactor Building Clean up	Comments
DBA	IHX Tube rupture	X	Y	X	X	W		X	X				X	X		No release. Possible actuation of dump tank to minimize leak into primary sytem
DBE	Leak of break of IHTS in Reactor Buidling	X	Y		X	GP						X		X		
DBE	Leak of break of IHTS outside Reactor Buidling	X	Y			W						X				
DBE	DRACS pipe rupture inside Reactor Building					GP						X				
DBE	DRACS NDHX Tube Rupture	—	—	—	—		—	—	—	—		X	—	—	—	
BDBE	Sodium Fire Inside Reactor Building in location with fire protection deck	X	Y	—	X	W	X	—	—	—	FP	—	—	X	—	
BDBE	Sodium Fire Inside Reactor Building in location w/o fire protection deck	X	Y											X	X	
BDBE	Sodium Fire outside Reactor Buidling	X				W										Depending on Location

Y-implies operation with 0.1% failed pins; W- implies operation of DUMP Tank; GP denotes Guard Pipe Protection; FP- denotes presence of fire protection deck

List of LBE considered for Functional Containment (4/4)

Operation or Transient Category	LBE	Fuel Matrix	Fuel Cladding	Primary Coolant	Coolant Processing	Guard Pipe/Dump Tank	Coolant Processing Compartment	Cover Gas	Cover Gas Processing	Cover gas Processing Compartment	Fire Suppression Deck	Shields to reduce activation	Reactor Top Closure Seals	Reactor Building Isolation	Reactor Building Clean up	Comments
BDBE <QHO Prompt	Postulated Severe accident	X	0%	X	—		—	—	—	—		—	79%	X	X	100% failure of all cladding of active and stored core. Cover gas pressurization lead to 23% max. leakage of cover gas. Reactor building leaks 1.0 Vol% /day
DBA	Protected Loss of Primary Flow	X	Y	X			—	—	—	—		—	—	—	—	Contained within primary system
DBA	Protected loss of Heat Sink	X	Y	X			—	—	—	—		—	—	—	—	
DBA	Protected Reactivity Insertion	X	Y	X			—	—	—	—		—	—	—	—	
BDBE	Unprotected Loss of Primary Flow	X	Y	X	X		—	—	—	—		—	—	—	—	
BDBE	Unprotected loss of Heat Sink	X	Y	X	X		—	—	—	—		—	—	—	—	
BDBE	Unprotected Reactivity Insertion	X	Y	X	X		—	—	—	—		—	—	—	—	
BDBE <QHO Prompt	Combined unprotected reactivity insertion and loss of heat sink	X	Y	X			—	—	—	—		—	—	—	—	Limited or no loss of cladding integrity if reactor shutdown within 3 hours after event

Y- implies operation with 0.1% failed pin

Functional Containments -Example Severe Accident (1/2)

- This is only case in which both passive Decay heat removal system (DRACS and RVACS) are assumed to be completely unavailable – so only heat sinks remove decay heat
- PRA has conservatively estimated failure of RVACS as 1.0E-06/yr and failure of DRACS as 1.5E-05/yr so their combined failure is less than 5.0E-7
- After 59.5 hours, the active core starts failing and all cladding (active core plus stored core (198 assemblies) has failed by 60.5 hours
- As temperatures of the primary coolant continue to rise, coolant volume expands to pressurize the cover gas until seals in the reactor top enclosure fail
  - Until seals fail, there are no releases to the reactor building. Once the seals start failing, the releases of cover gas increase to a maximum of 23 vol%/day.
  - At 72 hours, it is assumed that decay heat removal is re-established, pools stop expanding and leakage cannot get worse.
- Cover gas radioisotopes are released in the reactor building space and are assumed to leak to the environment at 1.0 Vol%/day
- Results are shown in the Table
- Frequency /consequence (F/C) is shown in the Figure on the next slide

Offsite Dose Results

Result	TEDE (rem)
Minimum Sampled Result	10.74
5th Percentile	16.52
Median	20.99
Mean	20.85
95th Percentile	24.67
Maximum Sample	31.07

Functional Containments -Example Severe Accident (2/2)

Result	TEDE (rem)
Minimum Sampled Result	10.74
5th Percentile	16.52
Median	20.99
Mean	20.85
95th Percentile	24.67
Maximum Sample	31.07