Preliminary Test Plan

VHTR Cooperative Agreement

Program Review Meeting

February 25, 2009

2 PRELIMINARY TEST MATRIX

Test Number	Test	Initial Conditions	Transient	Data Requirements
Depressurized Conduction Cooldown Reference Case (Prismatic Block Core)				
	All DCC Reference Cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-001	Double Ended Inlet-Outlet Duct Break			• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-002	Control Rod Drive Nozzle Break			• Break flow rate.
NRC-VHTR-003	Instrumentation Tube Break			• Break flow rate.
NRC-VHTR-004	Inlet Duct Break			• Break flow rate.
NRC-VHTR-005	Small break(s)			• Break flow rate.
NRC-VHTR-006	Double Ended Inlet-Outlet Duct Break Check Case			• Duct exchange flow rate. • Duct flow distribution.
Depressurized Conduction Cooldown Case (Prismatic Block Core) with Upper Plenum Gas Injection				
	All DCC Gas Injection Cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection.	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-007	Double Ended Inlet-Outlet Duct Break		• Inject gas into upper plenum. • Test can be repeated at different gas injection rates.	• Duct exchange flow rate. • Duct flow distribution.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Depressurized Conduction Cooldown Case (Prismatic Block Core) without Scram				
	All DCC ATWS Cases.	• Core Power: 600kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Integrated decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-008	Double Ended Inlet-Outlet Duct Break			• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-009	Control Rod Drive Nozzle Break			• Break flow rate.
Depressurized Conduction Cooldown Case (Prismatic Block Core) with Failed or Degraded RCCS Channels				
	All DCC with failed or degraded RCCS cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-010	Double Ended Inlet-Outlet Duct Break		• Failure of one RCCS channel.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-011	Double Ended Inlet-Outlet Duct Break		• Failure of multiple RCCS channels.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-012	Double Ended Inlet-Outlet Duct Break		• Off reference RCCS emissivity.	• Duct exchange flow rate. • Duct flow distribution.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Depressurized Conduction Cooldown Case (Prismatic Block Core) with Off Reference Spatial and Temporal Decay Power Distributions				
	All DCC with off reference spatial and temporal decay power distribution cases.	• Core Power: up to 600kW • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-013	Double Ended Inlet-Outlet Duct Break	• Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-014	Control Rod Drive Nozzle Break	• Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	• Break flow rate.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Pressurized Conduction Cooldown Case (Prismatic Block Core)				
	All PCC cases.	• Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Stop forced convection.	• Temperature distribution in core and reflector. • Gas temperature distribution in inlet plenum. • Core flow rate. • Core coolant flow distributions. • Bypass flow. • Reactor cavity air flow. • Temperature distribution in upper head, vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-015	Complete loss of flow	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution.	
NRC-VHTR-016	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Failure of one RCCS channel.	
NRC-VHTR-017	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Failure of multiple RCCS channels.	
NRC-VHTR-018	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Off reference RCCS emissivity.	
NRC-VHTR-019	Complete loss of flow with spatial and temporal power distribution.	• Core Power: up to 600kW • Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	
NRC-VHTR-020	Complete loss of flow without scram.	• Core Power: 600kW • Reference power shapes.	• Integrated decay heat power curve and distribution.	
NRC-VHTR-021	Outlet Duct Break	• Core Power: up to 18kW • Reference power shapes.	• Open break valve(s). • Reference decay heat power curve and distribution. • Power and forced convection can be adjusted based on design RPS response.	• Break flow rate. • Pressure drop across break.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Normal Operations Case (Prismatic Block Core)				
	All normal operations cases.	• Core Power: 600kW • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection		• Temperature distribution in core and reflector. • Gas temperature distribution in outlet plenum. • Core coolant flow distributions. • Bypass flow. • Reactor cavity air flow. • Temperature distribution in upper head, vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-022	Normal operations reference case.	Reference power shapes.		
NRC-VHTR-023	Partial loss of flow.	Reference power shapes.	• Block one or multiple flow channels. • Test can be repeated at different shapes and distributions.	
NRC-VHTR-024	Normal operations with spatial and temporal power distribution.	Off reference power shape(s).		
NRC-VHTR-025	Partial loss of flow with spatial and temporal power distribution.	Off reference power shape(s).	• Block one or multiple flow channels. • Test can be repeated at different shapes and distributions.	
Depressurized Conduction Cooldown Reference Case (Pebble Bed Core)				
	All DCC Reference Cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-026	Double Ended Inlet-Outlet Duct Break			• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-027	Control Rod Drive Nozzle Break			• Break flow rate.
NRC-VHTR-028	Instrumentation Tube Break			• Break flow rate.
NRC-VHTR-029	Inlet Duct Break			• Break flow rate.
NRC-VHTR-030	Small break(s)			• Break flow rate.
NRC-VHTR-031	Double Ended Inlet-Outlet Duct Break Check Case			• Duct exchange flow rate. • Duct flow distribution.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Depressurized Conduction Cooldown Case (Pebble Bed Core) with Upper Plenum Gas Injection				
	All DCC Gas Injection Cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection.	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-032	Double Ended Inlet-Outlet Duct Break		• Inject gas into upper plenum. • Test can be repeated at different gas injection rates.	• Duct exchange flow rate. • Duct flow distribution.
Depressurized Conduction Cooldown Case (Pebble Bed Core) without Scram				
	All DCC ATWS Cases.	• Core Power: 600kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Integrated decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-033	Double Ended Inlet-Outlet Duct Break			• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-034	Control Rod Drive Nozzle Break			• Break flow rate.
Depressurized Conduction Cooldown Case (Pebble Bed Core) with Failed or Degraded RCCS Channels				
	All DCC with failed or degraded RCCS cases.	• Core Power: 320kW • Reference power shapes. • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Reference decay heat power curve and distribution. • Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-035	Double Ended Inlet-Outlet Duct Break		• Failure of one RCCS channel.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-036	Double Ended Inlet-Outlet Duct Break		• Failure of multiple RCCS channels.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-037	Double Ended Inlet-Outlet Duct Break		• Off reference RCCS emissivity.	• Duct exchange flow rate. • Duct flow distribution.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Depressurized Conduction Cooldown Case (Pebble Bed Core) with Off Reference Spatial and Temporal Decay Power Distributions				
	All DCC with off reference spatial and temporal decay power distribution cases.	• Core Power: up to 600kW • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Stop forced convection. • Open break valve(s).	• Oxygen content distribution in vessel and cavity. • Temperature distribution in core and reflector. • Core flow rate. • Reactor cavity air flow. • Temperature distribution on vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-038	Double Ended Inlet-Outlet Duct Break	• Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	• Duct exchange flow rate. • Duct flow distribution.
NRC-VHTR-039	Control Rod Drive Nozzle Break	• Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	• Break flow rate.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Pressurized Conduction Cooldown Case (Pebble Bed Core)				
	All PCC cases.	• Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection	• Stop forced convection.	• Temperature distribution in core and reflector. • Gas temperature distribution in inlet plenum. • Core flow rate. • Core coolant flow distributions. • Annulus wall flow. • Reactor cavity air flow. • Temperature distribution in upper head, vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-040	Complete loss of flow	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution.	
NRC-VHTR-041	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Failure of one RCCS channel.	
NRC-VHTR-042	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Failure of multiple RCCS channels.	
NRC-VHTR-043	Complete loss of flow with failed or degraded RCCS channels.	• Core Power: 18kW • Reference power shapes.	• Reference decay heat power curve and distribution. • Off reference RCCS emissivity.	
NRC-VHTR-044	Complete loss of flow with spatial and temporal power distribution.	• Core Power: up to 600kW • Off reference power shape(s).	• Off reference decay heat power curve and distribution. • Test can be repeated at different shapes and distributions.	
NRC-VHTR-045	Complete loss of flow without scram.	• Core Power: 600kW • Reference power shapes.	• Integrated decay heat power curve and distribution.	
NRC-VHTR-046	Outlet Duct Break	• Core Power: up to 18kW • Reference power shapes.	• Open break valve(s). • Reference decay heat power curve and distribution. • Power and forced convection can be adjusted based on design RPS response.	• Break flow rate. • Pressure drop across break.

Test Number	Test	Initial Conditions	Transient	Data Requirements
Normal Operations Case (Pebble Bed Core)				
	All normal operations cases.	• Core Power: 600kW • Pressure: 0.4Mpa • Core Exit Temperature: 1000°C • Forced Convection		• Temperature distribution in core and reflector. • Gas temperature distribution in outlet plenum. • Core coolant flow distributions. • Annulus wall flow. • Reactor cavity air flow. • Temperature distribution in upper head, vessel and RCCS walls. • RCCS flow rate.
NRC-VHTR-047	Normal operations reference case.	Reference power shapes.		
NRC-VHTR-048	Partial loss of flow.	Reference power shapes.	• Block one or multiple sections of the core. • Test can be repeated at different shapes and distributions.	
NRC-VHTR-049	Normal operations with spatial and temporal power distribution.	Off reference power shape(s).		
NRC-VHTR-050	Partial loss of flow with spatial and temporal power distribution.	Off reference power shape(s).	• Block one or multiple sections of the core. • Test can be repeated at different shapes and distributions.	

Questions?

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