SMR -160

Briefing to the USNRC
July 26, 2012

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By
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Agenda

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- Introduction / Goal
- The Holtec Team
- Design Update
- Licensing Schedule
- Summary

Introduction / Goal

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- SMR, LLC is a subsidiary of Holtec International that is the developer of the SMR-160
- Previous Meetings with NRC
  - November 3, 2010 - Presentation of the principal performance goals
  - July 21, 2011 – Design Overview
- Holtec submitted a funding application to DOE on May 21, 2012
- Detailed design and analyses ongoing
- Goal of today's meeting
  - Present current design status
  - Discuss licensing issues
  - Discuss licensing schedule

One-Page Summary of Holtec International

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- 100% U.S. owned company. America's largest exporter of capital nuclear equipment.
- Customers in four continents: U.S.A., Mexico in North America; Brazil in South America; U.K., Switzerland, Spain, and Ukraine in Europe; China, Korea, Taiwan, and Japan in Asia.
- Over 80% of U.S. nuclear plants have Holtec-engineered systems in use.
- World leader in wet and dry storage of nuclear fuel.
- Excellent credit rating, no long-term debt.
- All manufacturing carried out in the United States.

Holtec Team for SMR-160

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] [per Affidavit 4(a) - 4(e)]

SMR-160 Design Overview

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- Performance
  - 525 MW Thermal
  - 160 MW Electrical
- Primary Loop
  - Natural Convection
  - 2250 psi
- Core Design
  - 37 full cross section assemblies, 8 ½ cross section assemblies
  - Standard 17x17 design, < 5 wt% Enrichment
  - No soluble boron
- SGs
  - Vertical, integrally connected to RV
  - Single stage with superheater

SMR-160 Overview

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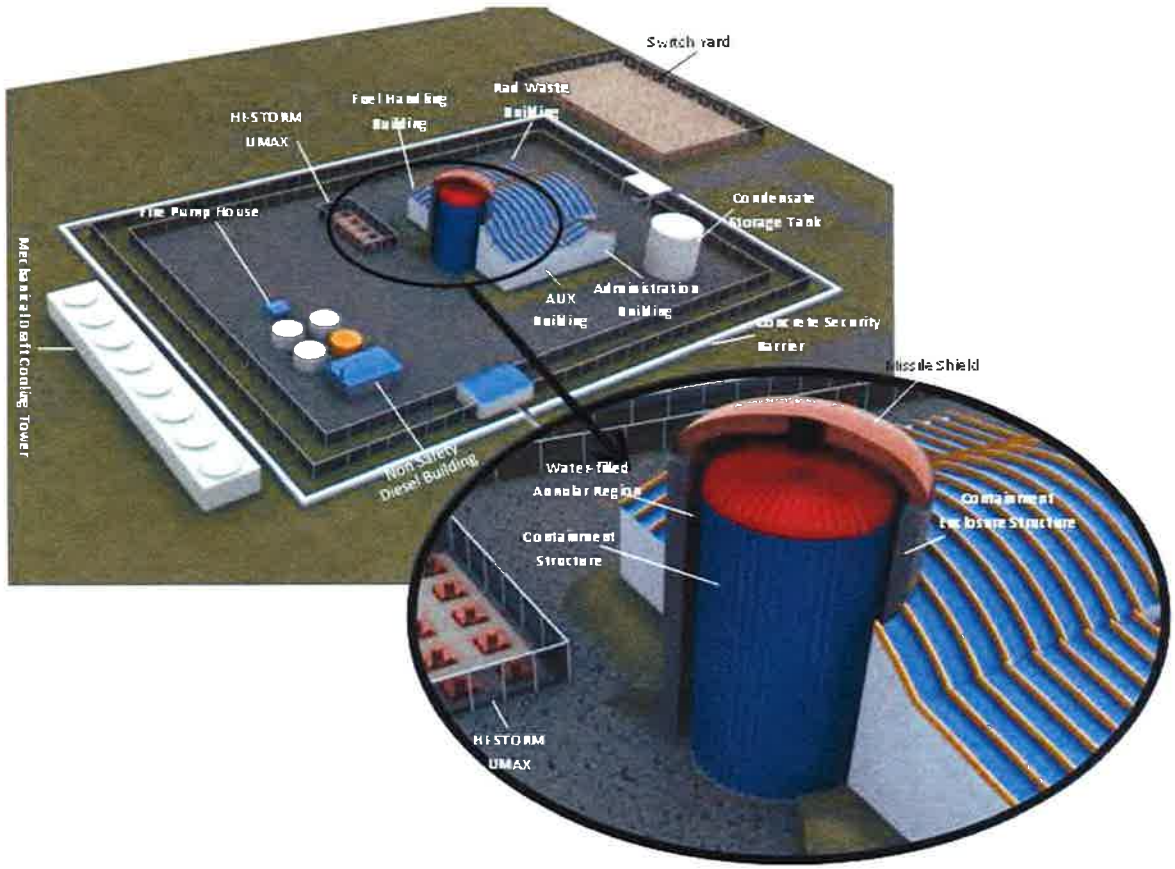
- Each unit is Autonomous
- Small footprint, <5 Acres and inconspicuous
- Short construction time, <3 Years
- Robust design for all accidents and beyond design basis accidents
  - Passive safety systems
  - Reactor is underground
  - Spent fuel storage underground
- Long re-fueling cycle, 4 years
- Short outage period, 5 days
- High capacity factor, >98%



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SMR-160 Overview

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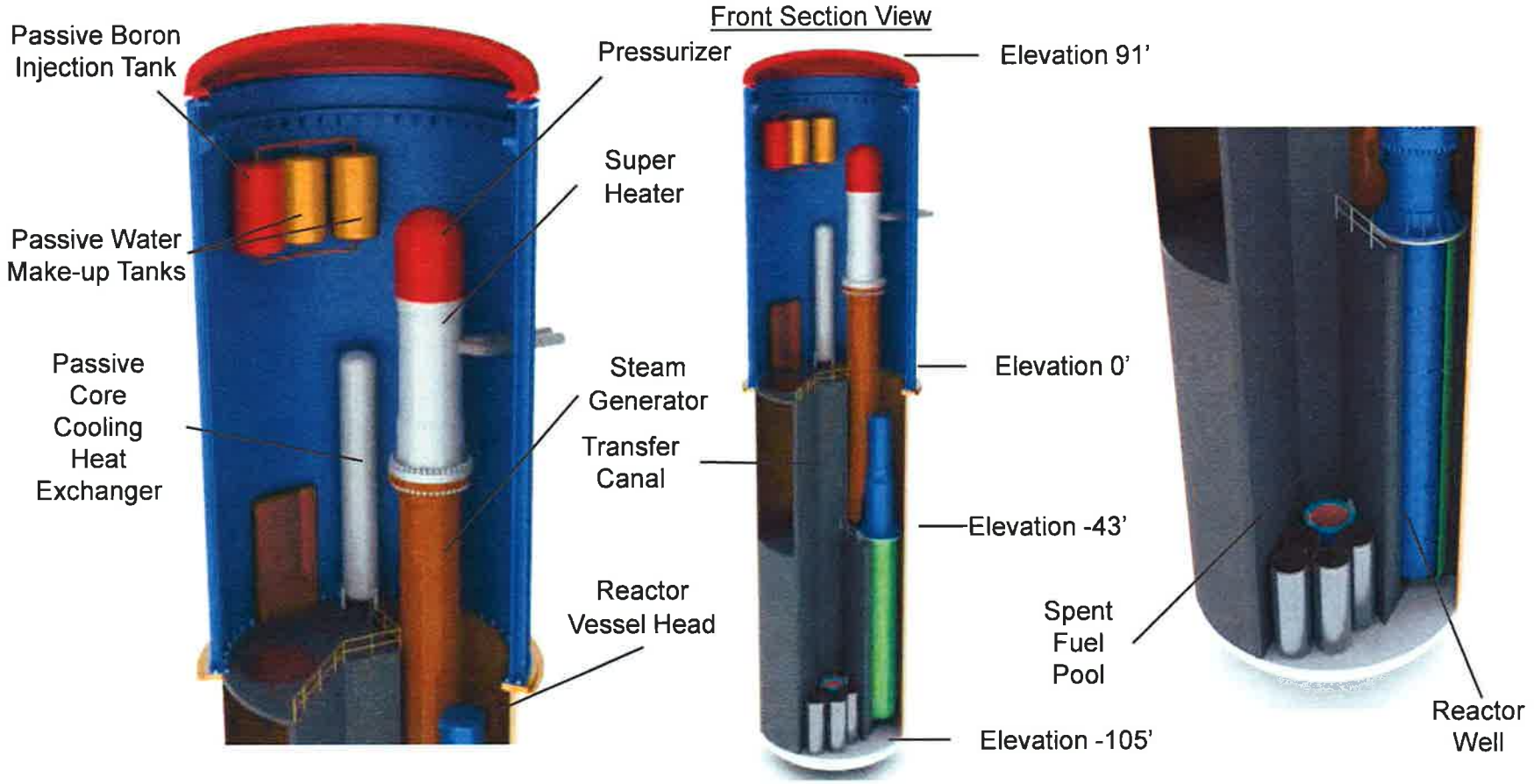

The containment is 45 feet in diameter.

Key Goals of the SMR-160

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Key Characteristics of the SMR-160 Design

Core located deep underground

Passive decay heat removal from the spent fuel pool and reactor core under off-normal conditions, including station blackout

Black start capability

Large inventory of water around & over the reactor core

Easy access to critical components

Simplified refueling operations

No penetrations in lower region of Reactor Vessel

Reactor coolant is demineralized water (high negative reactivity coefficient)

Improved Steam Cycle reliability through low pressure & high superheat

Simplified reactor pressure control

Prevention of fuel failures in reactor through reduced turbulence

All Safety Systems inside the Containment

Diesel power used only for non-safety functions (start up, DC battery charging)

SMR-160 Design Update

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- Reactor Coolant System (RCS)
  - Reactor Vessel (RV)
  - Steam Generator (SG)
- Containment
  - Containment Structure (CS)
  - Containment Enclosure Structure (CES)
- Engineered Safety Systems
  - Passive Containment Cooling System (PCCS)
  - Passive Core Cooling Systems (SBCS and EVCS)
  - Passive Spent Fuel Pool Cooling System
  - Passive Water Makeup System
  - Passive Boron Injection System
- Instrumentation and Controls

SMR-160 Design Update (cont.)

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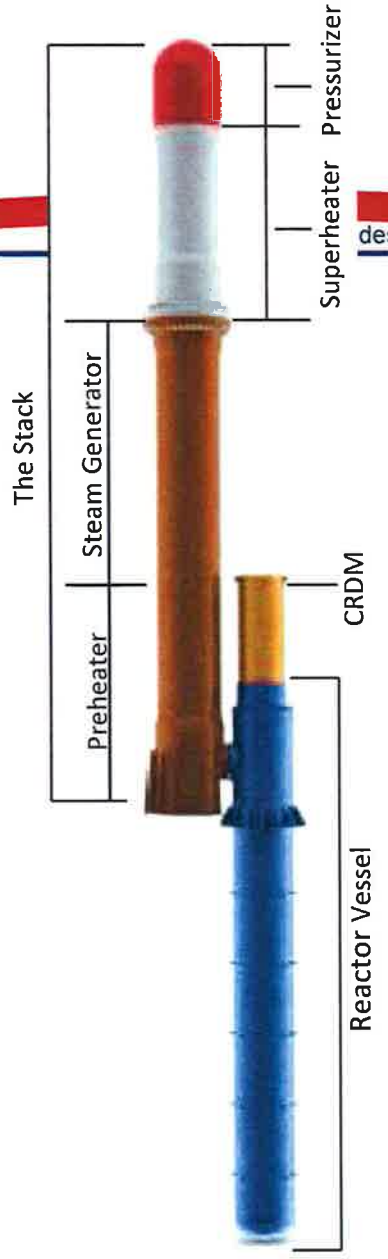
- Core Design
- Control Rod Drive Mechanisms
- Examples of Eliminated Safety Systems
- Steam and Power Conversion
- Start-up and Shut-down Systems
- Spent Fuel Management

Reactor Coolant System (RCS)

- Consists of the Reactor Vessel (RV) and the Steam Generator (SG)
- No reactor coolant pump
- Purely gravitational in all operational modes, including off-normal and accidents
- Driven by the heat generated in the core, i.e. is self-regulating
- More reliable and fewer systems



SMR design

Reactor Vessel (RV)

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] [per Affidavit 4(a) - 4(e)]

Reactor Vessel (RV) (Cont.)

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] [per Affidavit 4(a) - 4(e)]

Steam Generator

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] [per Affidavit 4(a) - 4(e)]

Containment Structure (CS)

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] [per Affidavit 4(a) - 4(e)]

Containment Enclosure Structure (CES)

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] [per Affidavit 4(a) - 4(e)]

Submerged Bundle Cooling System (SBCS)

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] [per Affidavit 4(a) - 4(e)]

External Vessel Cooling System (EVCS)

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] [per Affidavit 4(a) - 4(e)]

SFP Cooling

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] [per Affidavit 4(a) - 4(e)]

Passive Water/Boron Systems

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] [per Affidavit 4(a) - 4(e)]

Instrumentation and Controls

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] [per Affidavit 4(a) - 4(e)]

Core - Summary Table

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Number of Assemblies	37 Full Assemblies + 8 Partial
Fuel Loading [Metric Ton]	22
Fuel Type	Standard 17x17 PWR fuel dimensions
Active length [ft]	14
Burnable Absorber Segments (per FA)	8
Assembly Types	Up to 8
Maximum Enrichment [%]	4.95
Soluble Boron	No
Number of Cycles	1
Cycle length (fuel limit) in years	4
RCCA - Reactivity Control	17
RCCA - Axial Power Shaping	4
RCCA – Shutdown	16
Core Inlet Temperature [F]	384.5
Core Outlet Temperature [F]	600
Core Power [MWt]	525

Core – Fuel Cartridge

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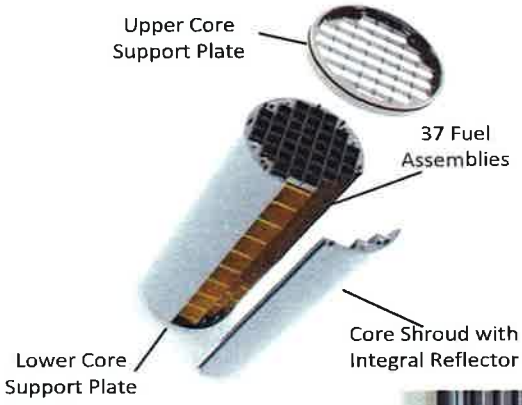
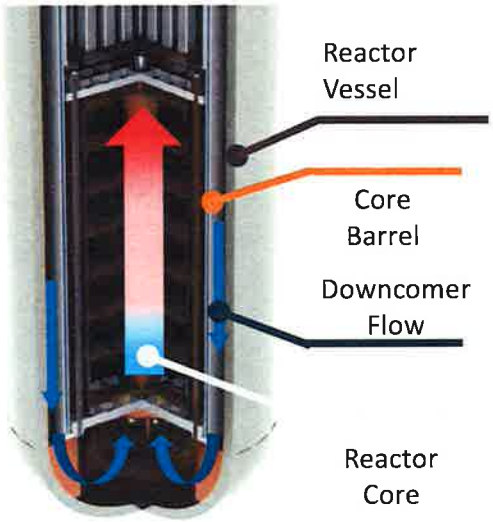
- Entire core is designed to be loaded and unloaded from the Reactor Vessel as a unitary structure called the Fuel Cartridge (FC).
- Enables Rapid Refueling: Refueling entails replacing a single cartridge;
- After burning in the core, the FC serves as the Wet Storage Rack and later, as the Dry Storage Basket
- Specialized Tooling required to remove fuel from the FC hardens the design against security threats
- Optimized Standard Core Design: All fuel assemblies in the FC are the same for each reload; no fuel shuffling required



Fuel Cartridg



Core Cross Section - Radial

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][CCI per Affidavit 4(a) - 4(e)]

Core Cross Section - Axial Arrangement of Burnable Absorbers

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] [per Affidavit 4(a) - 4(e)]

Core - Rod Cluster Control Assemblies (RCCAs)

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] [per Affidavit 4(a) - 4(e)]

Steam and Power Conversion

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] [per Affidavit 4(a) - 4(e)]

Spent Fuel Management

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] [per Affidavit 4(a) - 4(e)]

Examples of Eliminated Safety Systems

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] [per Affidavit 4(a) - 4(e)]

Licensing Approach and Schedule

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] [per Affidavit 4(a) - 4(e)]

Summary

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- Summary Discussions and Comments
- Closing Statements

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SMR-160 HEAT BALANCE

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] [per Affidavit 4(a) - 4(e)]

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] [per Affidavit 4(a) - 4(e)]

SMR-160 HEAT BALANCE

SIMPLIFIED HEAT BALANCE MODEL

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] [per Affidavit 4(a) - 4(e)]

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] [per Affidavit 4(a) - 4(e)]

SMR-160 HEAT BALANCE

PEPSE MODEL

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] [per Affidavit 4(a) - 4(e)]

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[

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SMR-160 START-UP AND SHUTDOWN SYSTEM

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START-UP & SHUTDOWN SYSTEM

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] [per Affidavit 4(a) - 4(e)]

START-UP & SHUTDOWN SYSTEM
(Start-up Operation)

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] [per Affidavit 4(a) - 4(e)]

START-UP & SHUTDOWN SYSTEM (Shutdown Operation)

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] [per Affidavit 4(a) - 4(e)]

START-UP & SHUTDOWN SYSTEM
(Refueling Operation)

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] [per Affidavit 4(a) - 4(e)]

START-UP & SHUTDOWN SYSTEM (Equipment)

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ENGINEERED SAFETY SYSTEMS

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SAFETY SYSTEMS - Overview

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[

] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS - Overview

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[

] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

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SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

Air Intake

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CONTAINMENT COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

HOLTEC INTERNATIONAL

a generation ahead by design

[

] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

Air Intake

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design

[

] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

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generation ahead by design

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE CORE COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE SPENT FUEL POOL COOLING SYSTEM

SAFETY SYSTEMS – PASSIVE SPENT FUEL POOL COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE SPENT FUEL POOL COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE SPENT FUEL POOL COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE SPENT FUEL POOL COOLING SYSTEM

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] [per Affidavit 4(a) - 4(e)]

SAFETY SYSTEMS – PASSIVE MAKEUP WATER SYSTEM PASSIVE BORON INJECTION SYSTEM

[

] [per Affidavit 4(a) - 4(e)]

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] [per Affidavit 4(a) - 4(e)]

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] [per Affidavit 4(a) - 4(e)]

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] [per Affidavit 4(a) - 4(e)]

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Control Rod Drive System

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July 16, 2012

Control Rod Drive System

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] [per Affidavit 4(a) - 4(e)]

Control Rod Drive Mechanism

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] [per Affidavit 4(a) - 4(e)]

Control Rod Drive Mechanism Design

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] [per Affidavit 4(a) - 4(e)]

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Rod Ejection Projection Device

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] [per Affidavit 4(a) - 4(e)]

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Drive Rod Grapple Assembly

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] [per Affidavit 4(a) - 4(e)]

Drive Rod Extension Assembly

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] [per Affidavit 4(a) - 4(e)]

Drive Rod Extension Support Structure

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[

] [per Affidavit 4(a) - 4(e)]