Xe-100 Load Following Capabilities & Nuclear Instrumentation Needs Mirion Connect Conference

Yvotte Brits

Supply Chain Manager & Operator Training Simulator Manager

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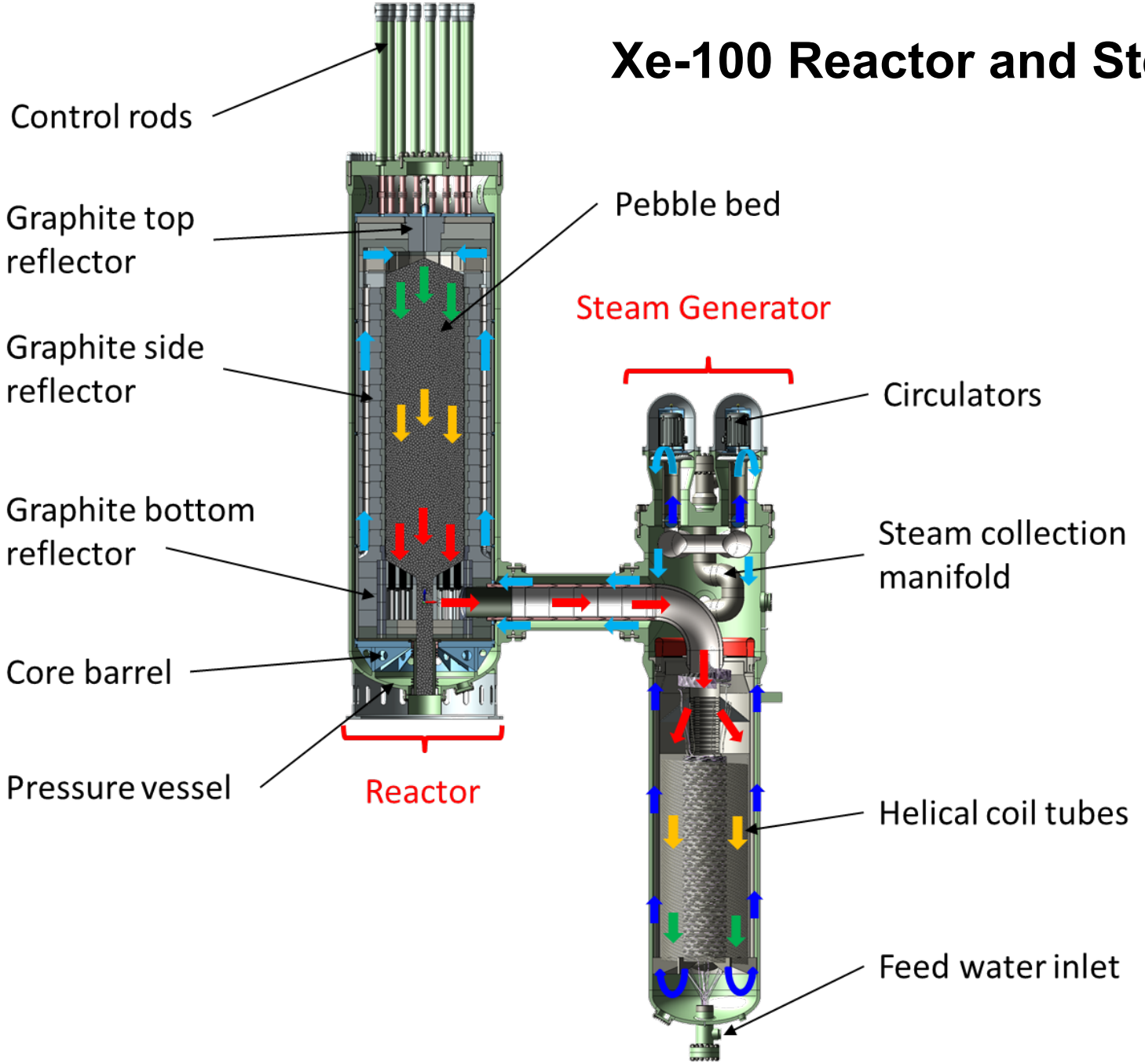
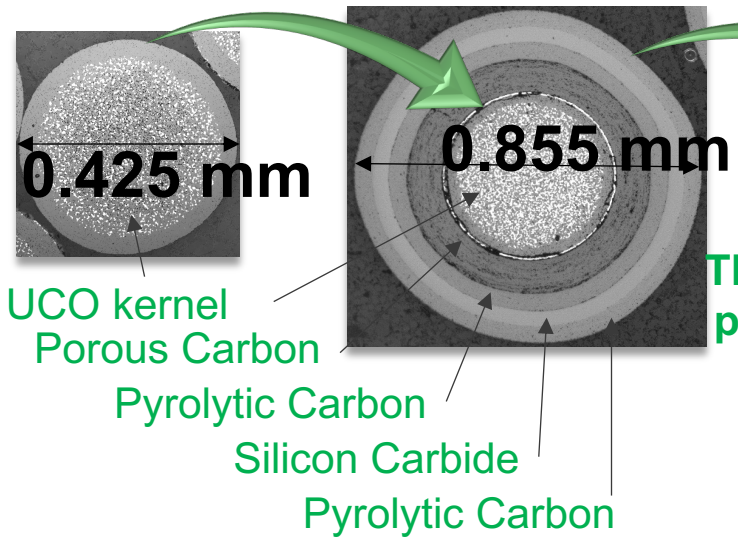
Xe-100 Reactor and Steam Generator Detail



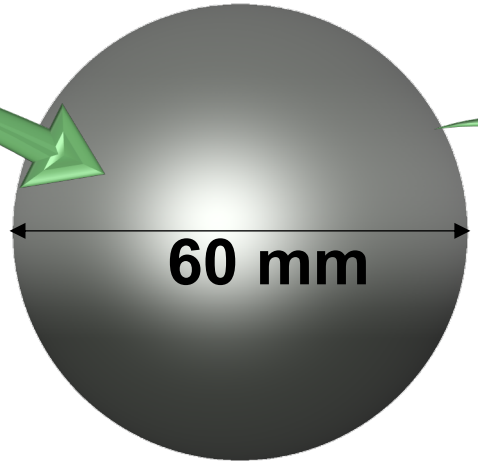
Key Technical Specifications

- 200 MWt Pebble Bed Reactor
- 15.5% enriched HALEU
- Rankine Cycle Power Conversion – 75 MWe
- Helical Coil Steam Generator
- Super Heated Steam at 565˚C/16.5 MPa
- Multi pass fuel cycle (average 6 passes)
- Online refueling
- Burnup up to 160 000 MWd/t

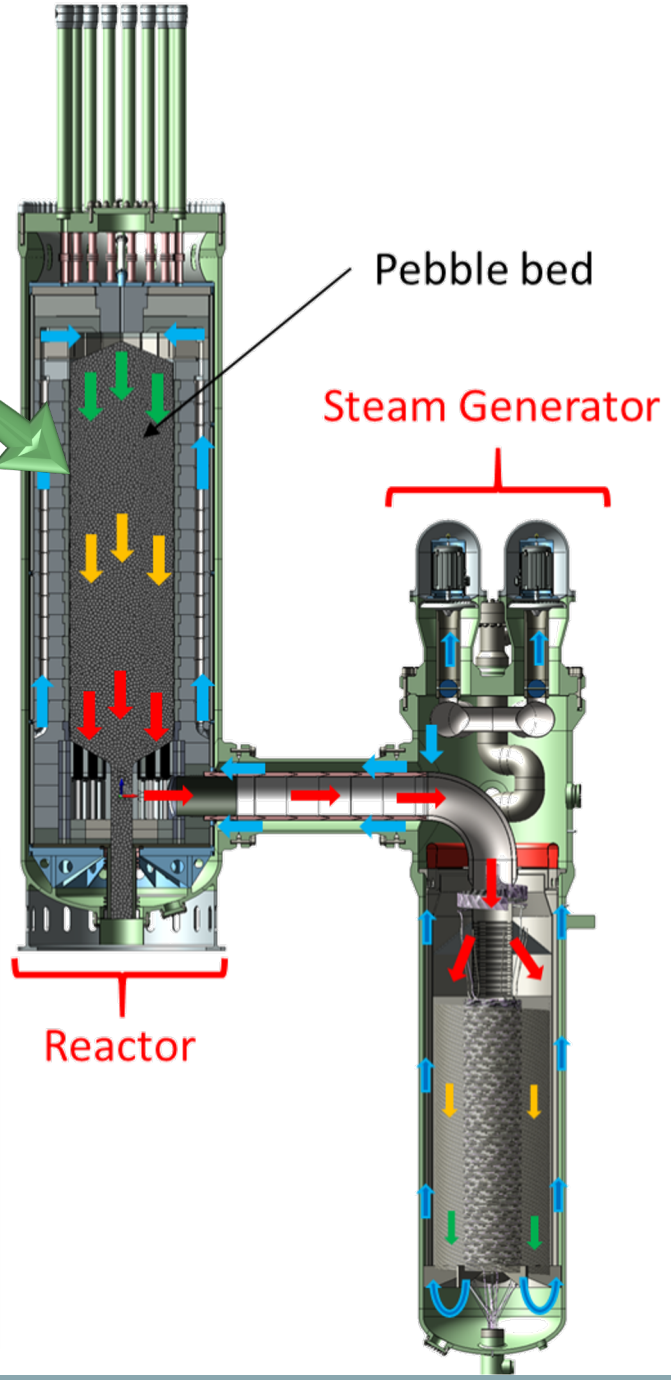
UCO TRISO Particle – Primary Fission Product Barrier



≈ 19 000 TRISO coated particles in a pebble

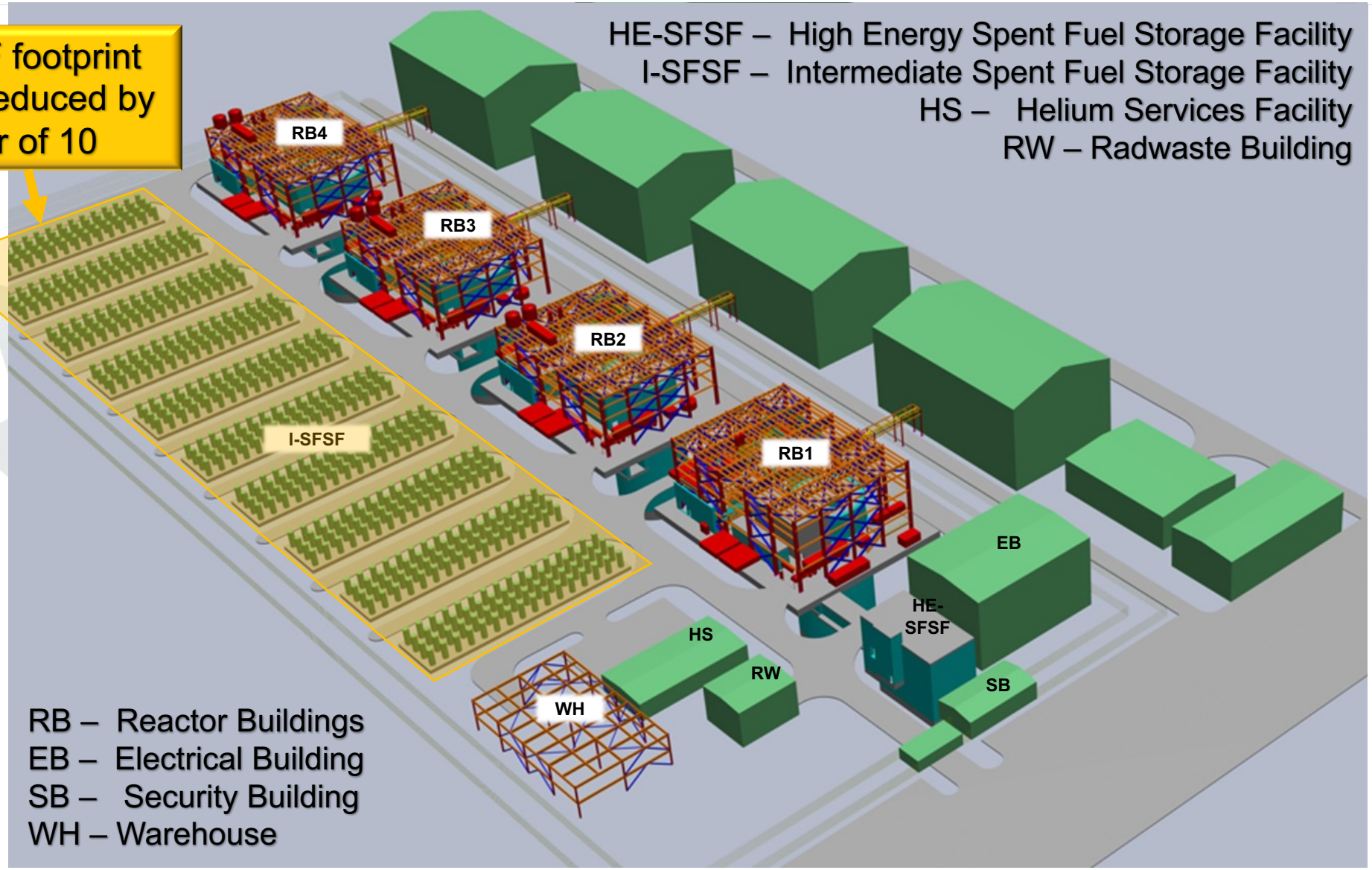


≈220 000 pebbles in the core



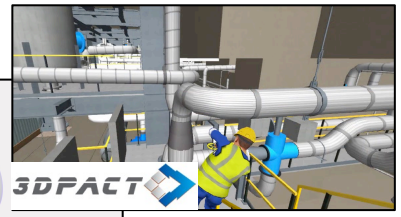
- Primary safety goal is to ensure that fission products are retained within the TRISO coated fuel particles to the maximum extent possible
- This is achieved through production of high quality TRISO fuel and ensuring that temperatures in the core never exceed the temperatures for which the fuel has been tested (AGR Experiments)

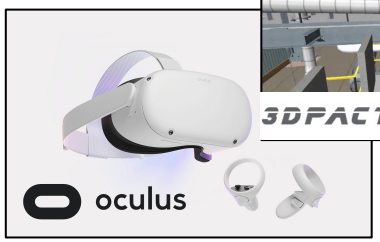
Standard Technology Offering (4-Reactor SmartPlant Model)

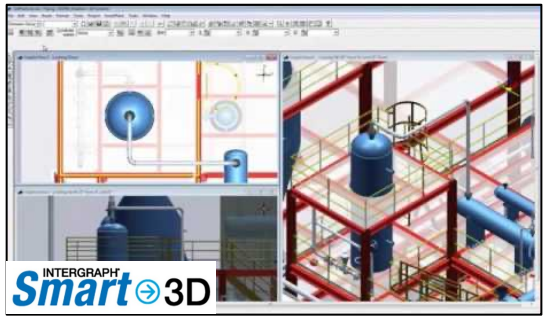


- Standard power plant consists of four independent Reactor Modules (Reactor and Steam Generator)
- Each reactor module is connected to its own Steam Turbine/Generator
- Single shared control room with only three operators

Xe-100 Digital Twin Tools

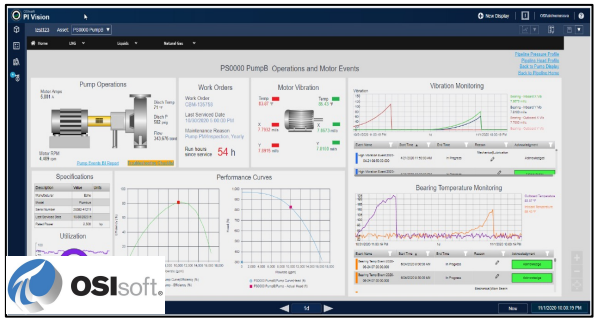




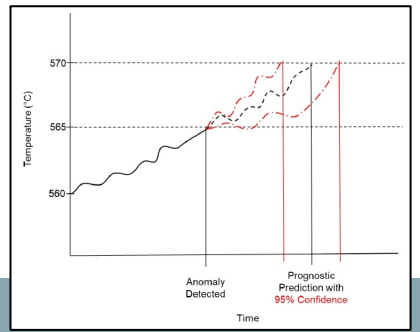


3D Models with AR / VR

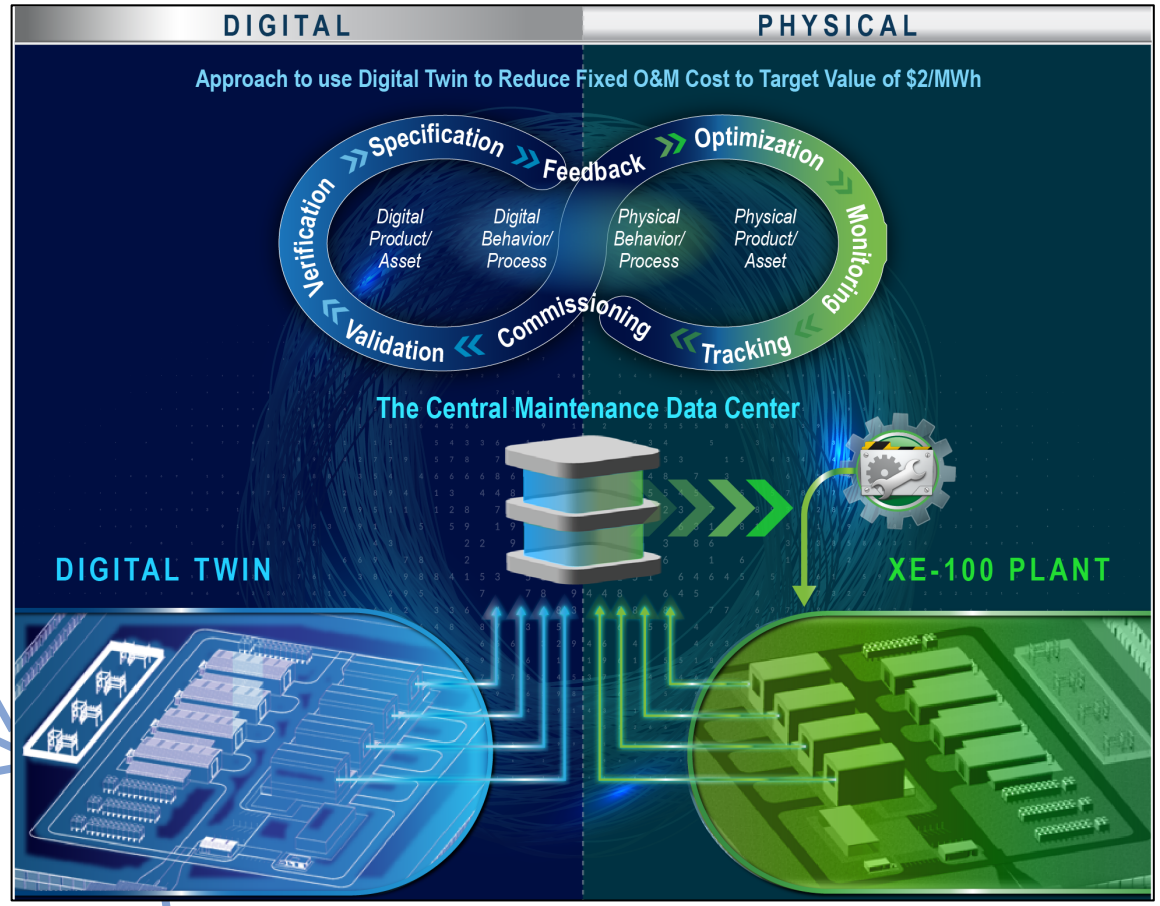
Operator Training Simulator



Plant Historian



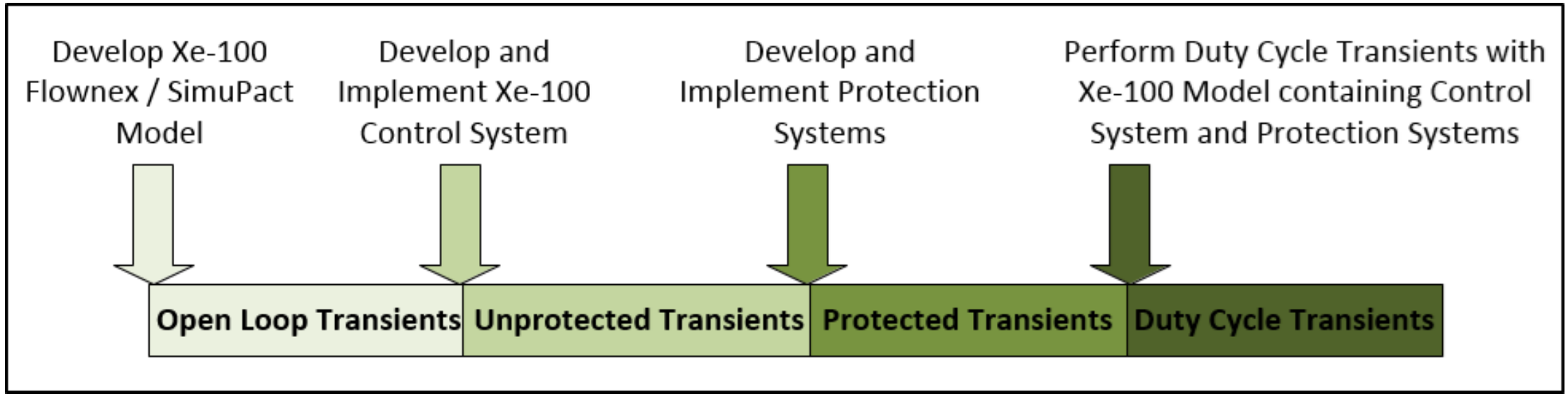
AI / ML Models



Xe-100 Site Drone Fly-Through in 3D PACT

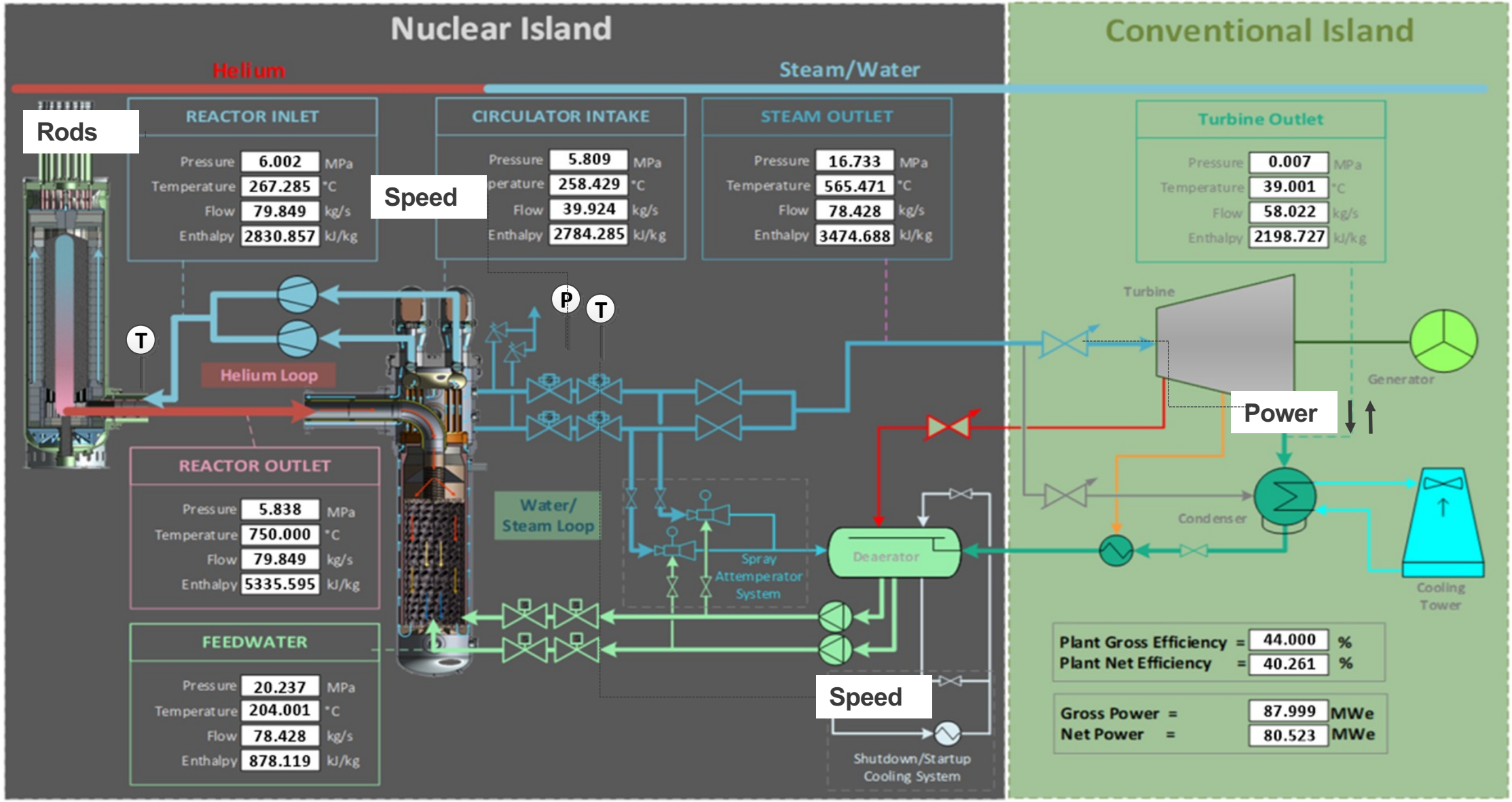
Control System Analysis Life Cycle

Yvotte Brits
Senior Nuclear Systems Engineer



Thermodynamic Cycle & Main Control Loops

Yvotte Brits
Senior Nuclear Systems Engineer



Control Approach

Yvotte Brits
Senior Nuclear Systems Engineer

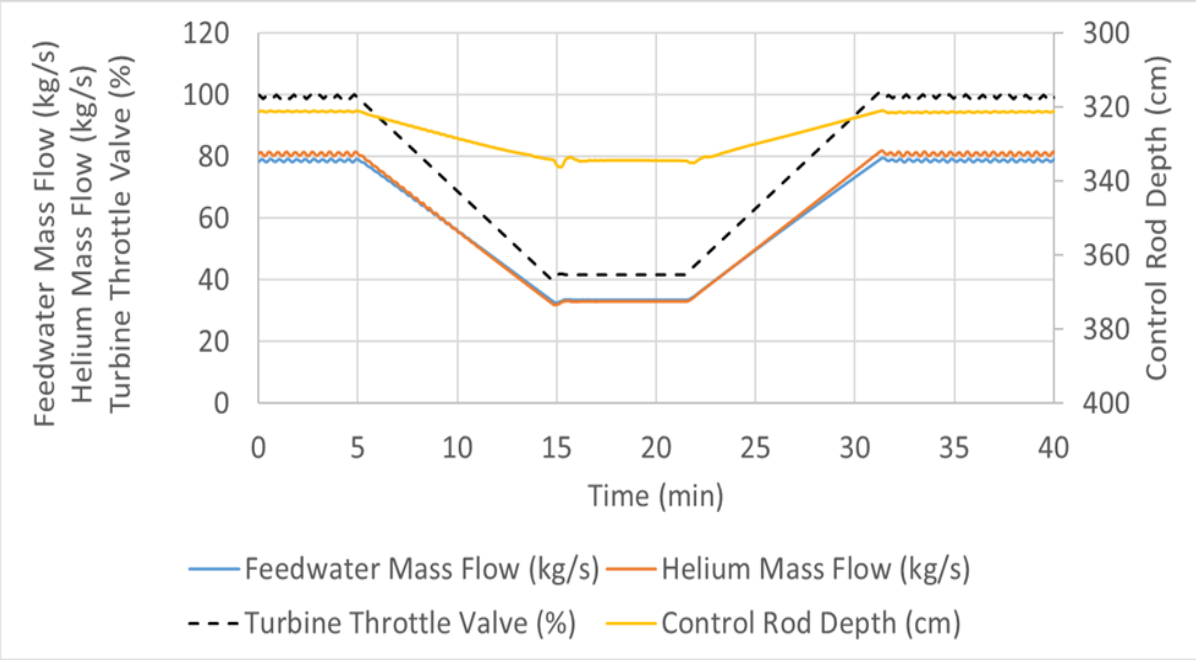
Controlled Variable	Set point	Manipulated Variable
Steam Generator Inlet Temperature	750°C	Control Rod Position
Main Steam Pressure	16.5 MPa	Helium Circulator Speed
Main Steam Temperature	565°C	HP Feed pump Speed
Electrical Load	40 – 100%	Turbine Throttle Valve Position

Extract from XE-100 Plant Distributed Control System Design Description

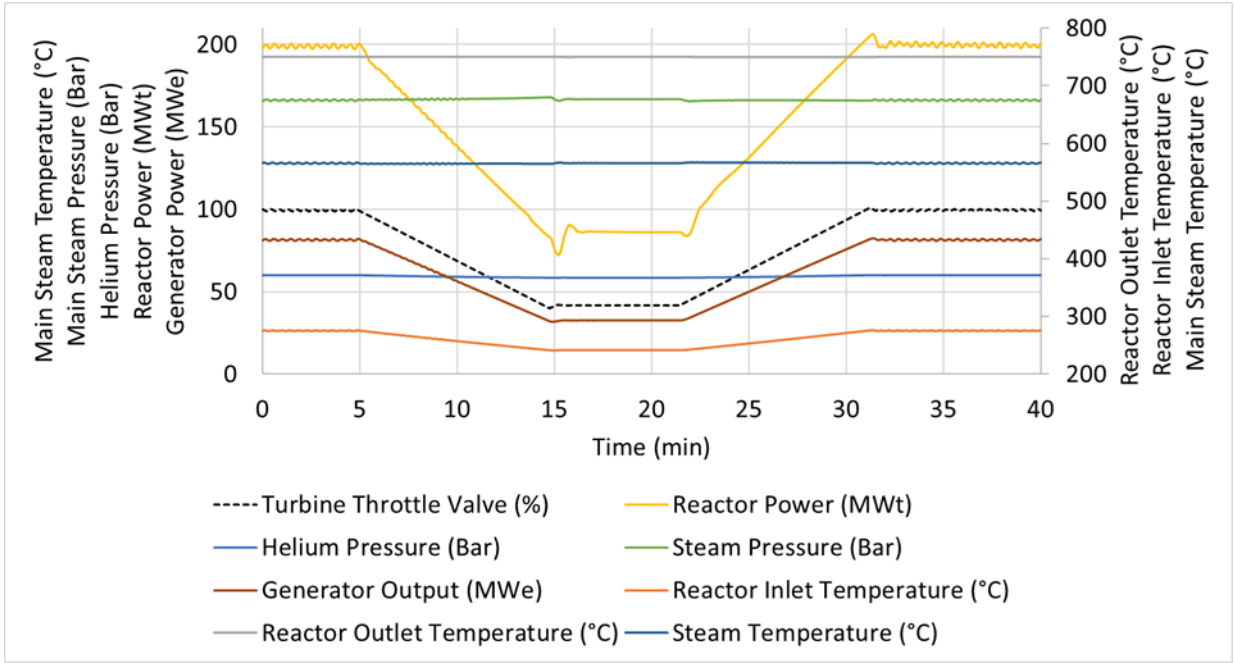
Load Following Transient Testing

Yvotte Brits
Senior Nuclear Systems Engineer

Control Actions



Plant Response



Extract from XE-E1-TG-H8-A08-100167_Xe-100 Module Load Following Transient Analyses – Rev 2

Xe-100 Mock-Up Control Room

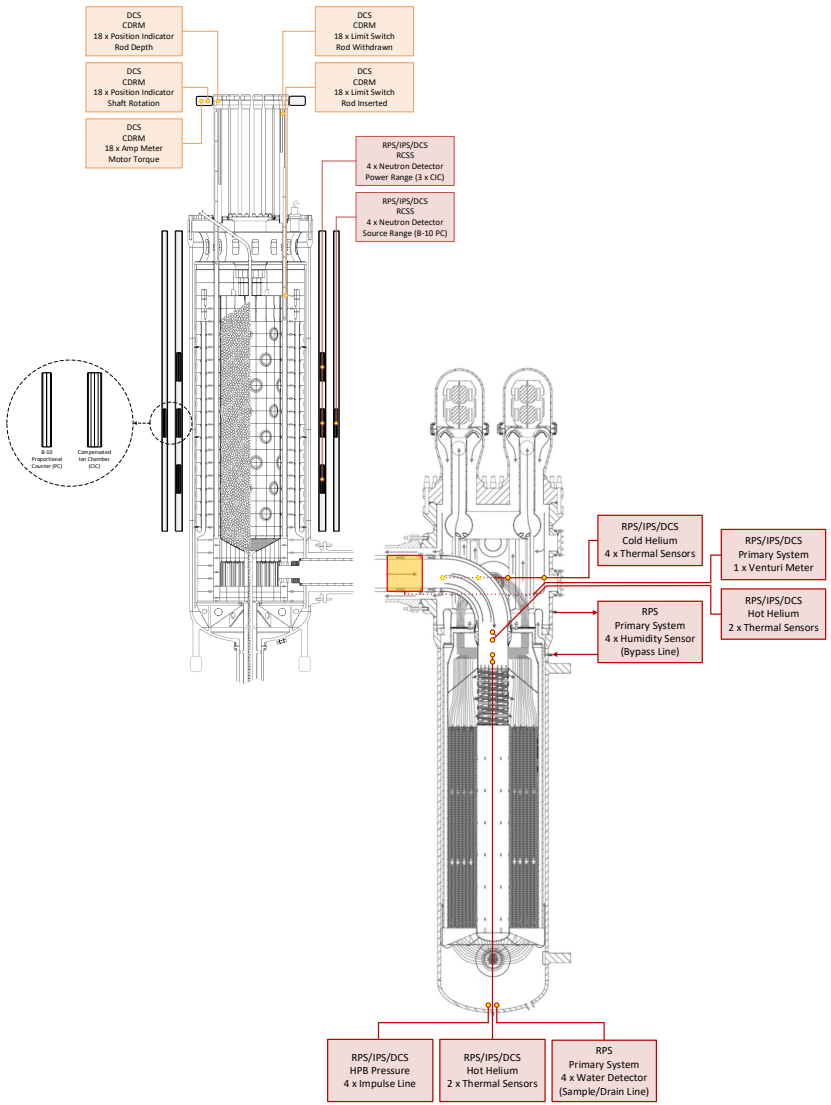
Xe-100 Nuclear Instrumentation Needs

Nuclear Instrumentation

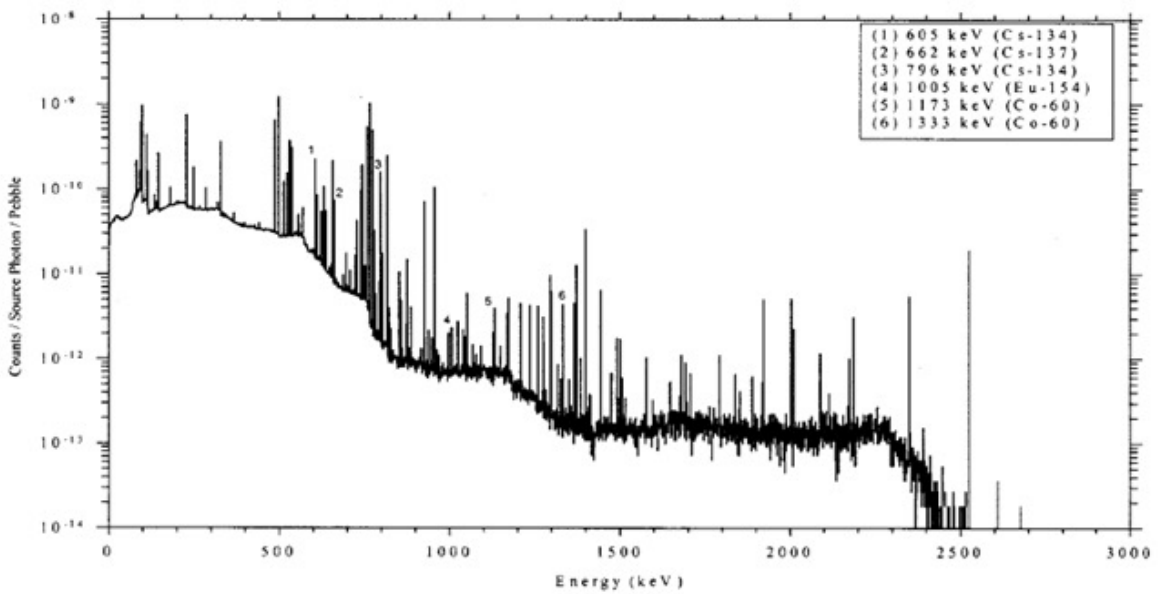
- Reactor System
- Steam Generator System
- Helium Circulator System
- Reactor Protection System

Sensor Types

- Thermal (RTD + Thermocouple)
- Absolute Pressure
- Differential Pressure
- Humidity or Moisture Concentration
- Liquid Water Sensors (capacitive or inductive)
- Helium Mass Flow
- Feedwater Mass Flow
- Signal Conditioners and Transducers



Burn Up Measurement System



. 3. An MCNP calculated gamma-ray spectrum for a discharged pebble at the end-of-life (80 000 MWD/MTU). Some of the main gamma-ray lines for the licators of Table I are marked on the spectrum.

TABLE I

CANDIDATE NUCLIDES FOR USE AS BURNUP INDICATORS[a]

Radionuclide	Half-life (years)	$\bar{\sigma}_\alpha$ (barns)	Major gamma-rays (keV), (% yield)	U-235 Cumulative Fission yield	Pu-239 Cumulative Fission yield	ORIGEN2.1 single pass activity (Ci / Pebble)	MDA (gamma line) (Ci) Estimated
Cs-137	30.04	0.222	662 (85.1)	0.0626	0.0673	0.1345	0.0007
Eu-154	8.59	1955	123 (40.57), 723 (20.11) 1005 (17.91), 1275 (35.0)	0.0041[b]	0.0043[b]	0.0006	0.0011 (1005) 0.0004 (1275)
Cs-134	2.06	123.6	569 (15.38), 605 (97.62) 796 (85.53)	0.067[c]	0.070[c]	0.0117	0.0009 (605) 0.0003 (796)
Co-60	5.27	2.57	1173 (99.97), 1333 (99.99)	N/A	N/A	0.0065	0.0002 (1173) 0.0001 (1333)

Summary

- The Xe-100 Plant can perform load following from 100%-40%-100% at a ramp rate of 5% per minute
- The Xe-100 Plant have an average TRL level of 7 and above, which enable's the use of COTS systems and components
- The first Xe-100 Plant will be commissioned by 2027 in the US

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