Union of Concerned Scientists

NIRS Webinar: Baffle Bolt Issue

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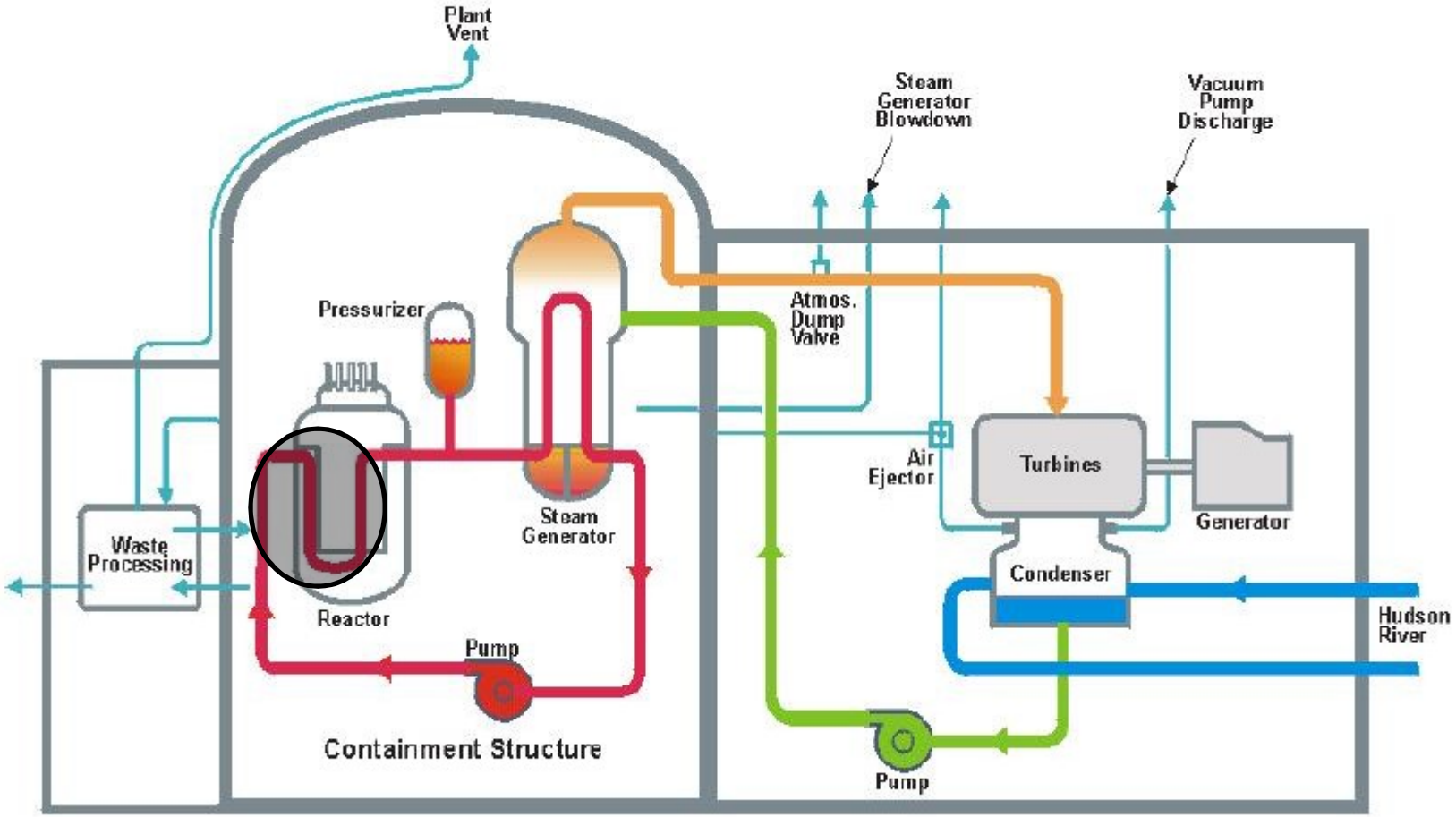
Who?

Workers at the Indian Point nuclear plant in New York identified aging degradation in more than 10 percent of the core baffle/former bolts on the Unit 2 pressurized water reactor.

Core baffle bolts are installed in U.S. pressurized water reactors (about two-thirds of the U.S. fleet of nuclear reactors.)

U.S. boiling water reactors (the other third) use metal hemispheres that are welded (rather than bolted) together to make the core shroud.

What?



The core baffle and former plates surround the nuclear fuel to direct cooling water through the core.

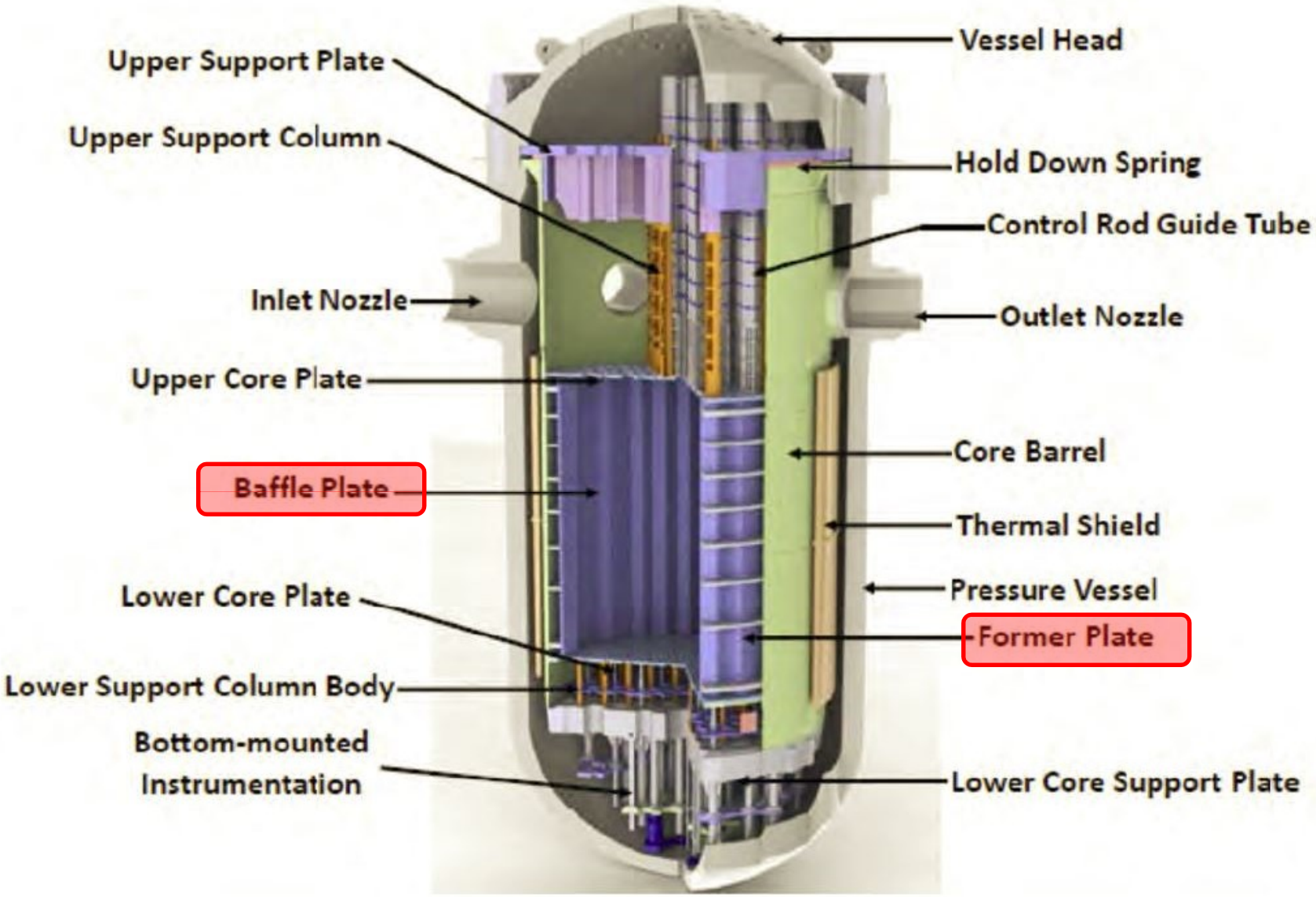
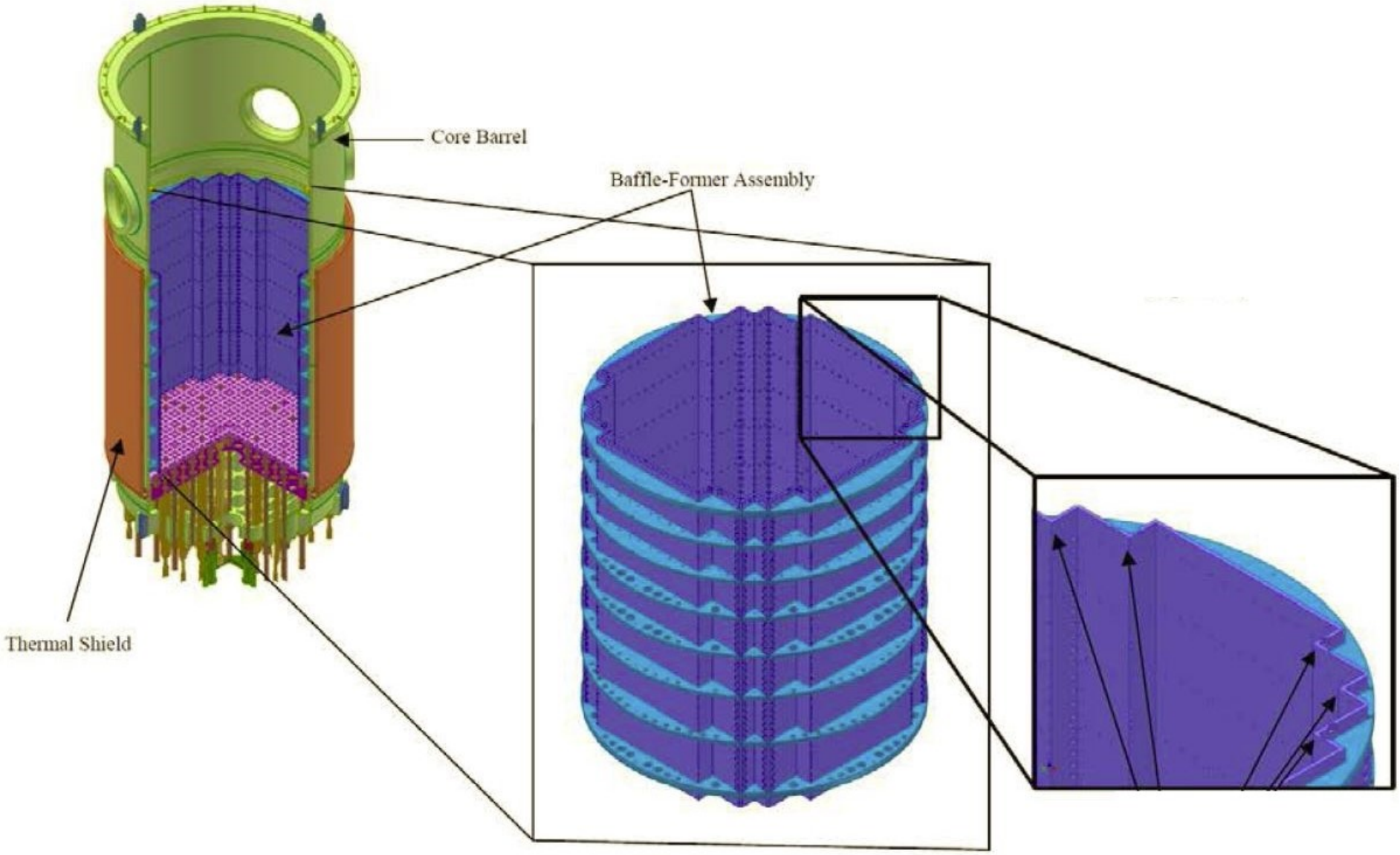
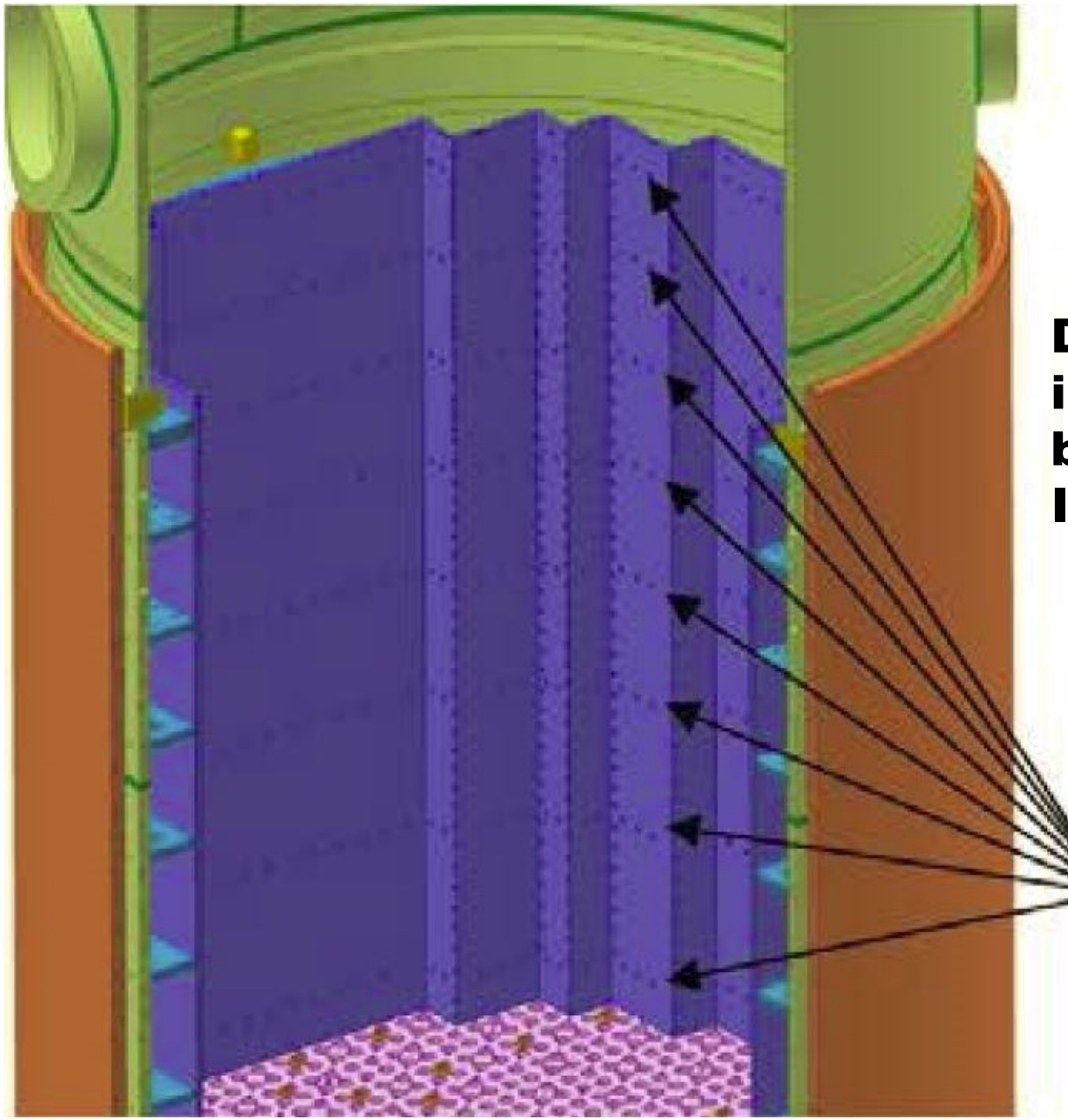


Figure 1 – Overview of Typical Westinghouse-design Reactor Vessel Internals (reproduced from update Westinghouse Figures Presented at Public Meeting on MRP-227, Rev. 1, March 31, 2015, ADAMS Accession No. ML15091A136 Ex. NRC000211)

Source: ML15337A264

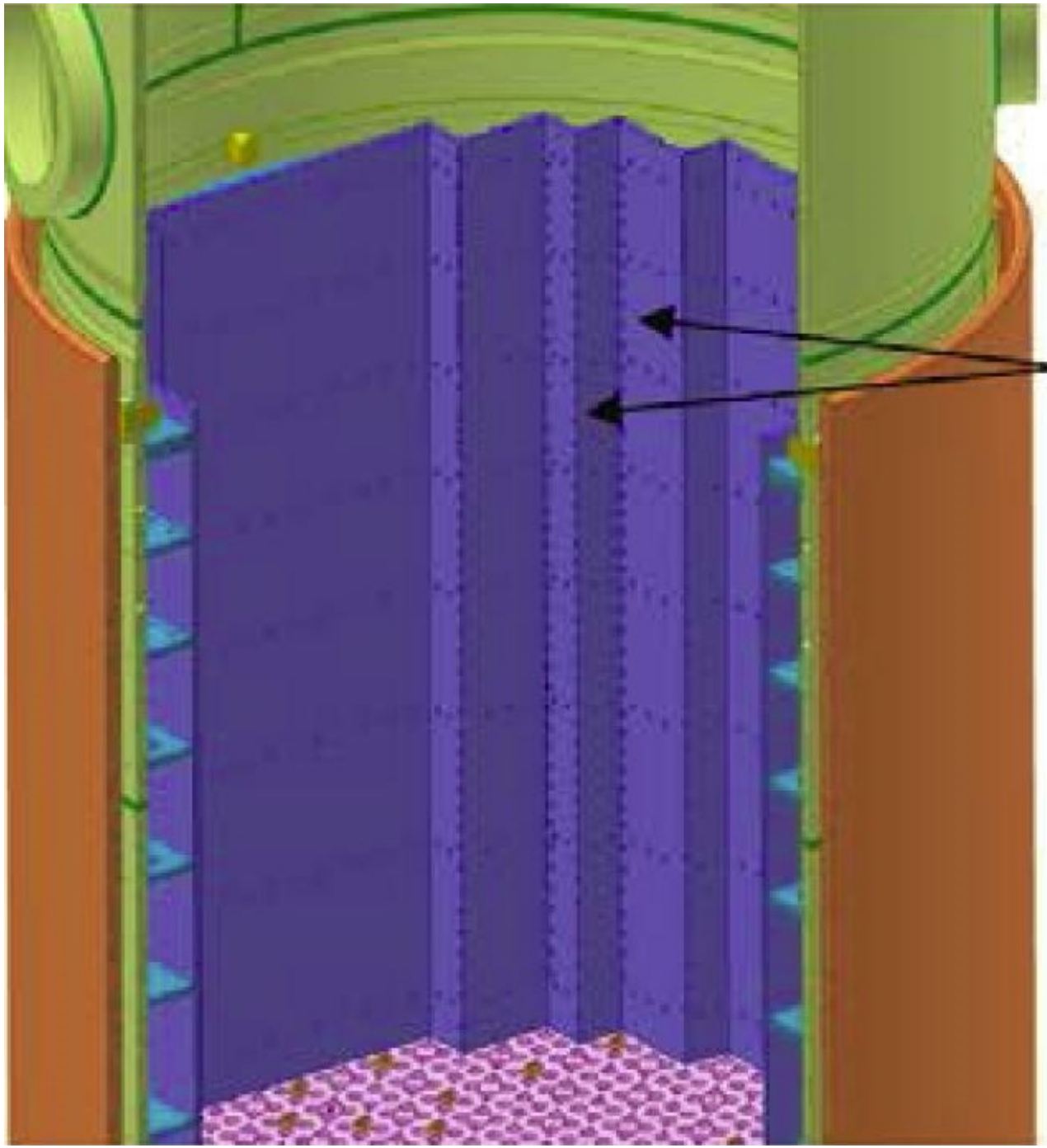


Source: ML15334A231



Degradation was found in 227 of the 832 (27%) baffle-former bolts at Indian Point Unit 2.

Source: ML15334A231



Baffle – Former
Edge Bolts

Type 316 stainless steel

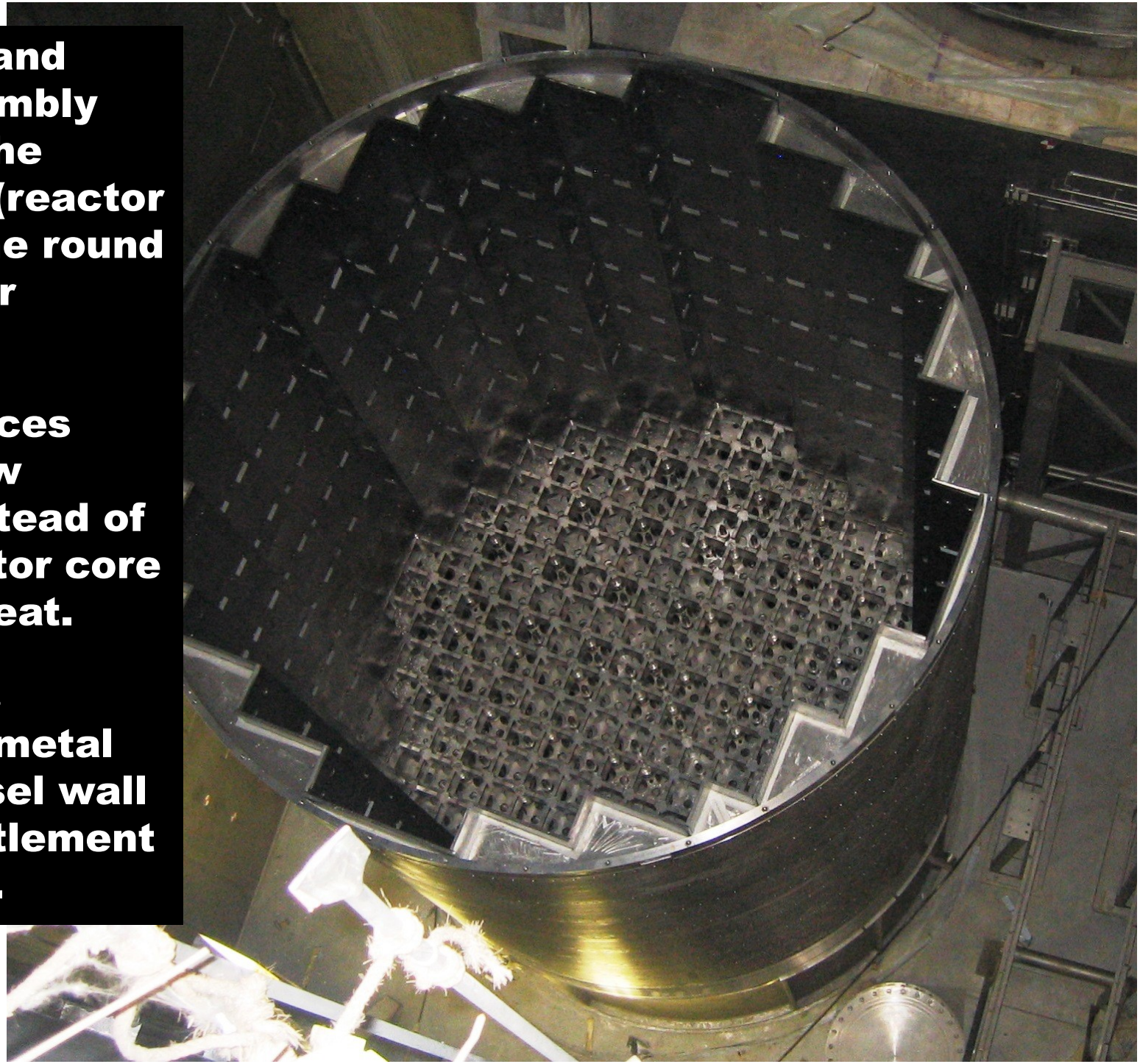
Each quadrant contains 50 bolts
in 3 columns and 41 bolts
in 4 columns for a total of
1,256 baffle-former edge bolts

Source: ML15334A231

Core baffle and former assembly allows fits the square peg (reactor core) into the round hole (reactor vessel).

Intact, it forces water to flow through, instead of by, the reactor core to remove heat.

It also helps protect the metal reactor vessel wall from embrittlement by neutrons.



Looking down into the upper core barrel and core baffle and former assembly of a pressurized water reactor.

When?

Table 5-2
Primary Components at IPEC Units 2 and 3

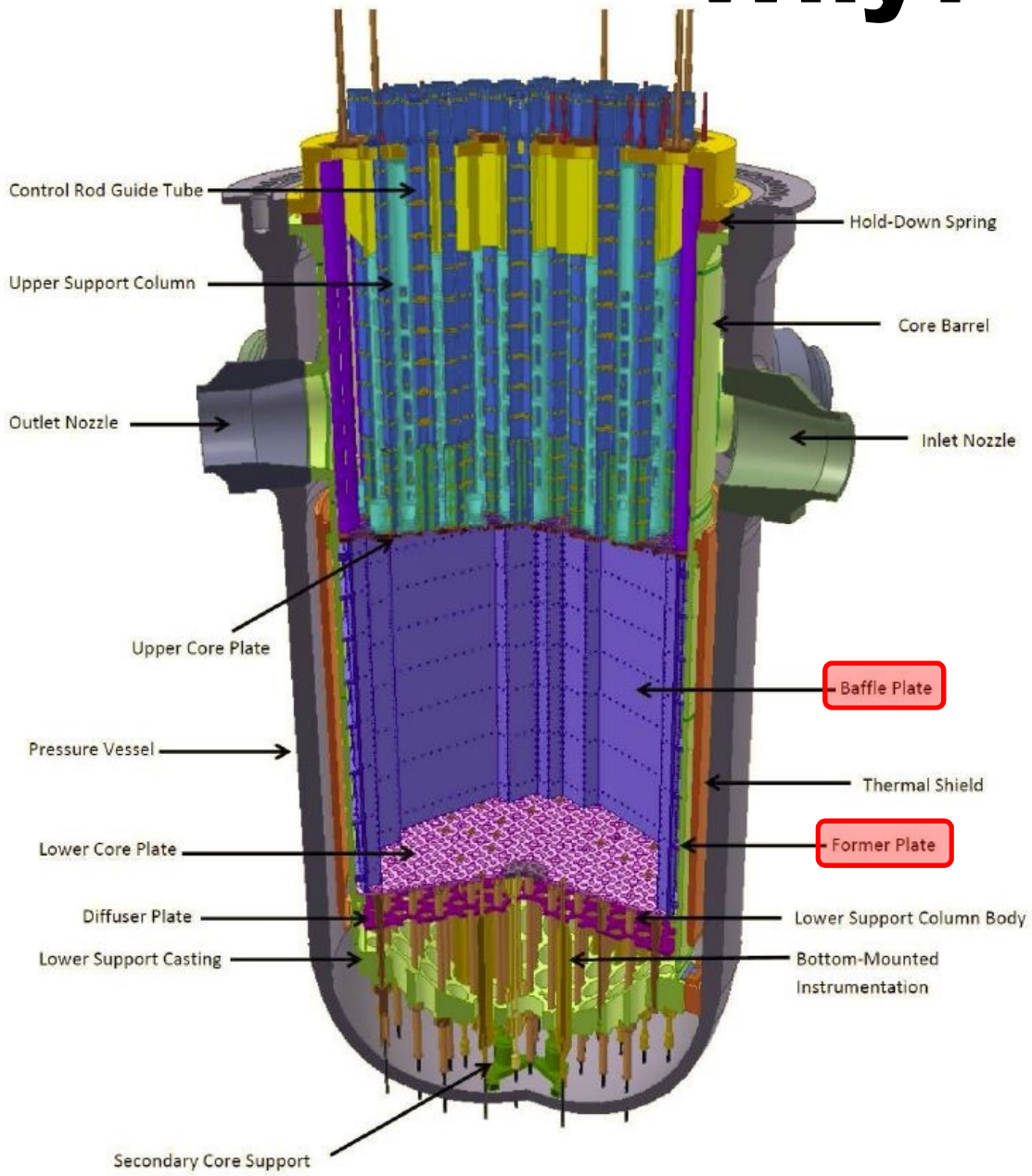
Item	Applicability	Effect (Mechanism)	Expansion Link	Examination Method/Frequency	Examination Coverage
Baffle-Former Assembly Assembly (Includes: Baffle plates, baffle edge bolts and indirect effects of void swelling in former plates)	IPEC Units 2 and 3	Distortion (Void Swelling), or Cracking (IASCC) that results in • Abnormal interaction with fuel assemblies • Gaps along high fluence baffle joint • Vertical displacement of baffle plates near high fluence joint • Broken or damaged edge bolt locking systems along high fluence baffle joint	None	Visual (VT-3) examination to check for evidence of distortion, with baseline examination between 20 and 40 EFPY and subsequent examinations on a ten-year interval.	Core side surface as indicated. See Figures 2-6, 2-7, 2-8 and 2-9.

The core baffle and former assembly, including the bolts, is first inspected after the reactor has operated for 20 to 40 effective full power years (EFPY) and then every 10 years thereafter (EPRI MRP-227).

Workers inspected the Indian Point Unit baffle bolts for the first time in March 2016.

Source: ML15331A179

Why?



Safety Concern: Coolable Geometry

NRC's regulations require emergency core cooling systems be capable of maintaining a coolable geometry for the reactor core.

If the baffle and former assembly do not remain intact, water can enter and leave the reactor vessel without passing through, and cooling, the core.

Source: ML15334A231

Safety Concern:
Loose Parts, Impingement, and Obstruction

2007 – Workers plugged a steam generator tube on Millstone Unit 3 in Connecticut due to damage caused by impact from a foreign object.

2003 – Vibrations following power uprate cracked the steam dryer atop the reactor core of the Quad Cities Unit 1 reactor in Illinois. Impact markings on the impeller of recirculation pump 1B suggest that pieces from the broken dryer traveled through the pump.

1982 – NRC warned plant owners about fuel rods that were damaged by impingement from water jetting through gaps in the core baffles.

Unanswered Questions (so far)

1) What about the core former bolts on Indian Point Unit 3, a virtually identical reactor with nearly the same operating history?

2) Was degradation detected in the core former bolts during prior inspections? If not, why not?

3) PWRs have loose parts monitoring systems (called the Metal Impact Monitoring System at Indian Point). Were loose parts from broken bolts detected by this system? If so, why did the reactor continue operating? If not, why not?

4) Will all pieces of degraded bolts (e.g., missing bolt heads) be found and recovered?

5) If all missing pieces are not recovered, what damage could the pieces cause (e.g., interfering with control rod and valve movements, damage fuel rods and steam generator tubes, etc.)?