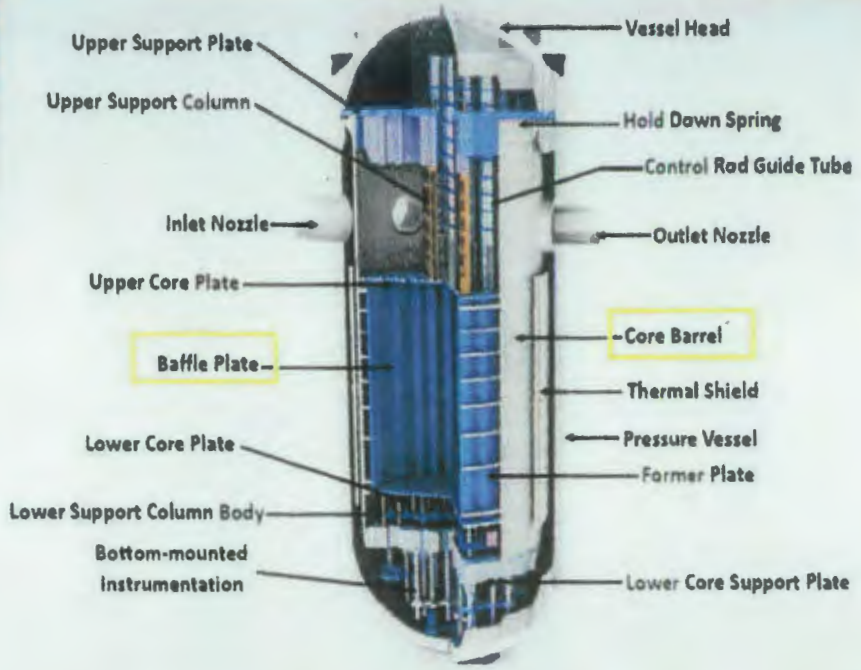
Briefing on Indian Point Baffle Bolt Inspections

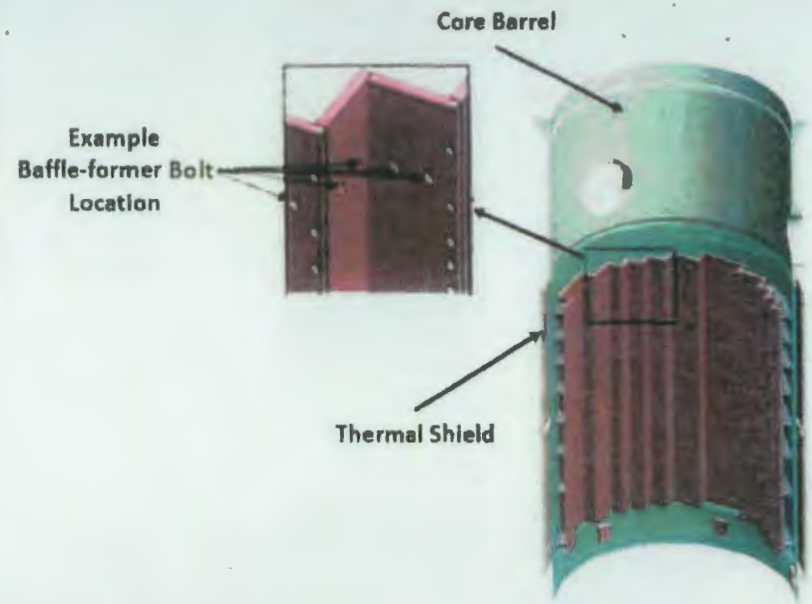
April 19, 2016

Protecting People and the Environment

Enclosure 1

Baffle-former assembly



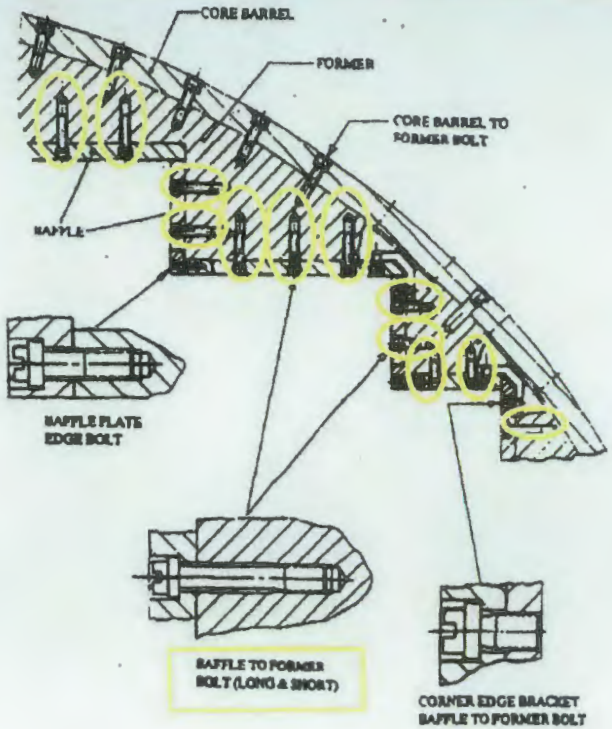


Function of baffle-former assembly is to direct coolant flow through the core. It also provides lateral support to the core during a seismic event or loss-of-coolant accident (LOCA).

[redacted]

[redacted]

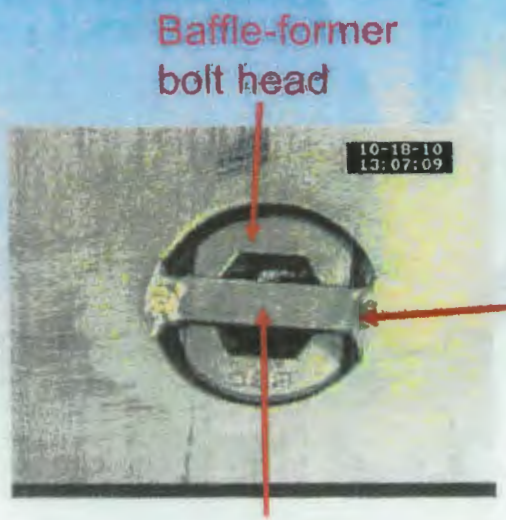
Baffle-former bolts



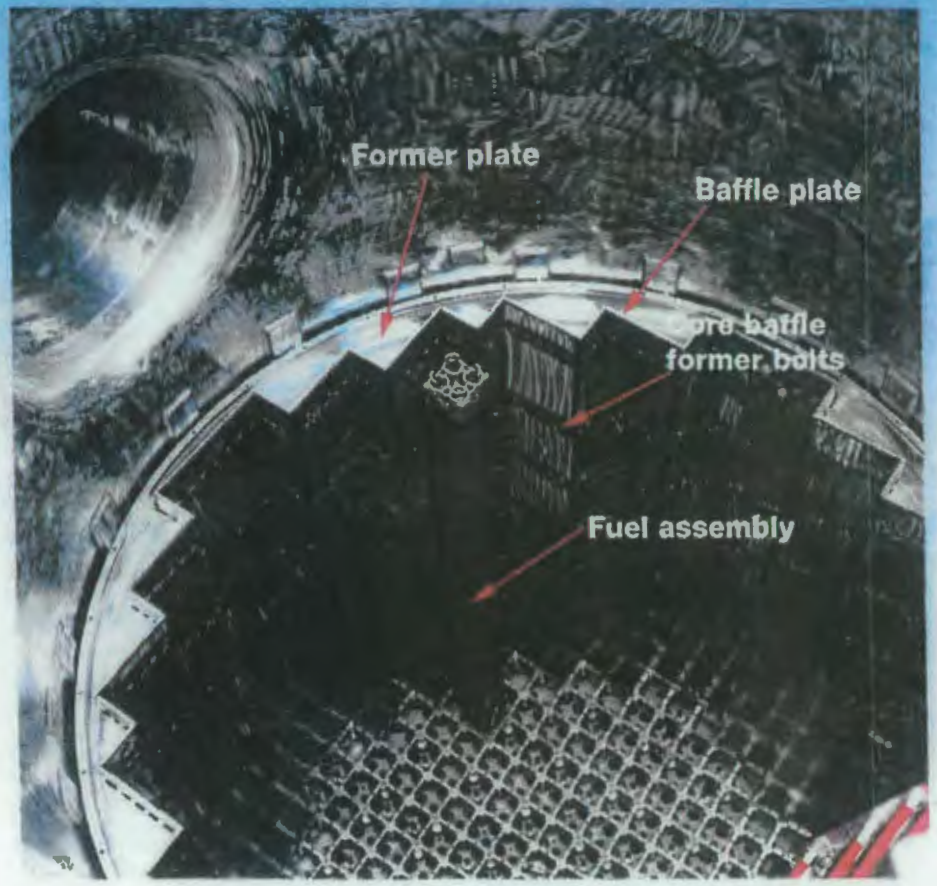
8 levels 7 baffle bolt

832 at 102

- Stainless steel bolts are 5/8" dia. x ~2" long and attach the baffle plates to the former **plates** to **form** the baffle assembly



Potential consequences



- No impact from a few bolt failures
- Large numbers of failed bolts could cause:
  - Flow leakage through gaps between adjacent plates
    - Fuel degradation (baffle jetting erosion)
    - Increased core bypass flow (less fuel cooling)
  - Baffle plates impacting fuel assemblies during LOCA event, potentially leading to grid deformation

[redacted]

Baffle-Former Bolt Inspections – Regulatory Basis – First 40 years

- 10 CFR 50.55a "Codes and Standards"
  - Incorporates by Reference ASME Code, Section XI
  - Section XI mandates general visual condition examination of reactor vessel internals (RVI) every 10 years
- All PWRs have been performing every 10 years during the first 40 years of operation

Baffle-Former Bolt Inspections Regulatory Basis – Period of Extended Operation

- Guidance for PWR RVI aging management program is based on NRC-approved topical report MRP-227-A
- To manage aging of RVI, IP2 committed to enhanced inspections following MRP-227-A, consistent with NRC guidance

MRP-227-A Inspection Requirements for Baffle-Former Bolts

- Ultrasonic (UT) Examination
- Initial (baseline) inspection between 25-35 effective full power years
- 100% of bolts
- Inspect every 10 years thereafter
- All PWRs with baffle-former bolts must perform these inspections (most PWR designs)

2016 Indian Point Results

Entergy Unit 2 Activities

- Conducted visual examination of 1232 baffle-edge bolts
- Conducted ultrasonic and visual examination of 832 baffle-former bolts
- Results:
  - All baffle edge-bolts were acceptable
  - 227 total baffle-former bolt identified as failed
    - 182 ultrasonic testing failures
    - 31 visually identified as protruding [redacted]
    - 14 inaccessible, conservatively assumed failed
- Bolts to be sent out for analysis by Westinghouse and LPI, an independent engineering firm

2016 Indian Point Activities

Indian Point Unit 2 (IP2)

- Removing degraded bolts using mechanical extraction and Electrical Discharge Machining (EDM) tools
- Developing plans to replace baffle-former bolts
- Developing safety evaluation of as-found condition
- Developing analysis to support baffle-former assembly return to service (if not all bolts are replaced)

Indian Point Unit 3 (IP3)

- Developing evaluation of baffle-former assembly considering information from IP2
- Evaluating schedule for future baffle bolt examinations, currently planned in 2019 [redacted]

NRC Inspections to Ensure Safety Of Indian Point Unit 2

- Evaluated Entergy's Inservice Inspection to verify their examination methods/acceptance criteria were appropriate

- Baseline Inspections being planned and implemented to:
  - Verify Entergy completes bolt replacement and analyses that ensure the baffle-former assembly will perform intended safety functions
  - Review Entergy's evaluation of the as-found conditions to independently assess the safety significance and whether there were prior performance issues

NRC Inspections to Ensure Safety Of Indian Point Unit 3

- **NRC staff's current assessment is that IP3 is safe to operate**
  - Smaller number of failed bolts expected because:
    - IP3's baffle-former bolts are exposed to less radiation than those in IP2
    - Less operating time than IP2
    - No current indication of fuel leaks which would indicate significant problems with baffle-former bolts
  - Analysis for other Westinghouse plants have demonstrated significant margin regarding the total number of required bolts
  - Will reassess IP3 functionality based on results of IP2 analysis currently in progress
- **Resident Inspectors onsite to independently assess if conditions change**
- **NRC will review Entergy's evaluation of IP3 and their plans for future baffle-former assembly exams**

Operating Experience – Inspection Results

- Only one plant found broken baffle-former bolts via Section XI visual inspections
- Over 12,000 baffle-former bolts ultrasonically inspected to date
- Only 3.6% defective (potentially cracked)
- Excluding IP2 results, 2% defective
- Several plants of similar age or older to IP2 have inspected
- These older plants have found no more than 10% defective bolts

Industry Response

- Entergy will perform root cause analysis
- Results will be shared with the industry through the EPRI Materials Reliability Program (MRP)
- EPRI considers MRP-227-A a living program
- Changes can be made in response to operating experience

NRC Response

- Region I and NRR monitoring IP2 analysis, repair and root cause, and IP3 implications
- Decide if regulatory action needed based on:
  - Operating experience with baffle-former bolt inspections
  - IP2 root cause analysis results
  - Operability of IP2 under all design basis conditions with as-found defective bolts
- Potential actions could include acceleration of baseline inspection schedule, shorten reinspection interval, or no change
- Could implement through modification to guidance, or generic communication if warranted by safety impact