framatome

GAIA Fuel Assembly: proven robustness & performance for 17x17 reactor fleet

Dounia Lhachemi

October 20-21, 2026



pwr PRAGUE 2026

What Defines a High-Performance Fuel Assembly?

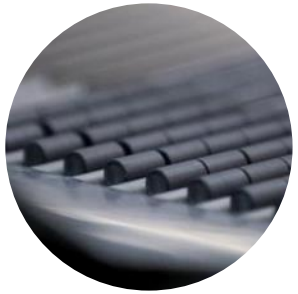
Reliability
- Outstanding in-core mechanical behavior
- Resistance to grid-to-rod fretting and fuel rod failure



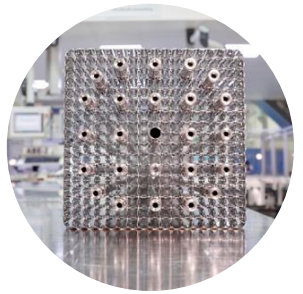
Safety
- Robust behavior in normal and transient conditions
- Large operational margins







Operability
- Support diverse fuel management
- Mixed core compatibility



Performance
- Support Extended Power uprates (EPU)

The best fuel assembly is not the one that maximizes a single parameter, but the one that optimally **balances safety, reliability, flexibility**, and **performance**

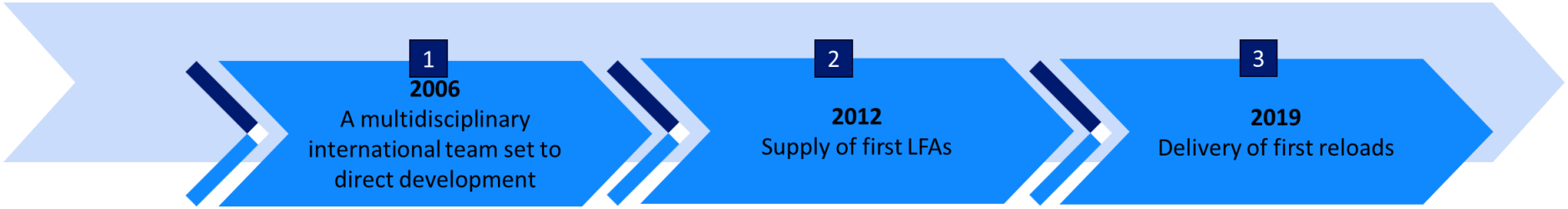
framatome

Property of Framatome © Framatome – All rights reserved

Origine of Framatome GAIA 17x17 Fuel Assembly

Genesis of the project and objectives:

- Develop a unified next-generation PWR fuel assembly platform to replace Framatome's legacy regional designs while streamlining the product portfolio.
- Build on proven fuel design features, complemented by selected innovations, to ensure robust deployment and licensing success.
- Address evolving utility requirements, including higher burnup, extended operating cycles up to 24 months and power uprates
- Compliant with all 12ft and 14ft reactor designs





Property of Framatome © Framatome – All rights reserved

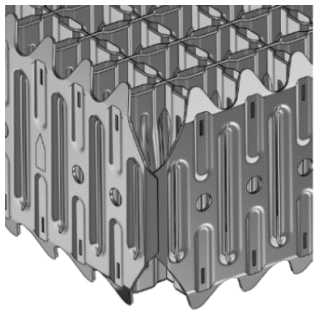
GAIA FA: First-class fuel reliability

Grid to Rod Fretting

GAIA



HMP

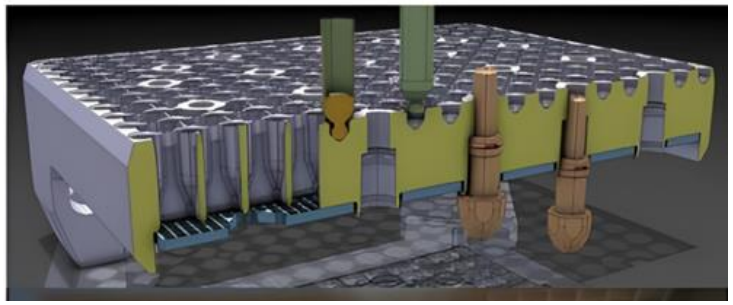


Line contact for GAIA & HMP spacers

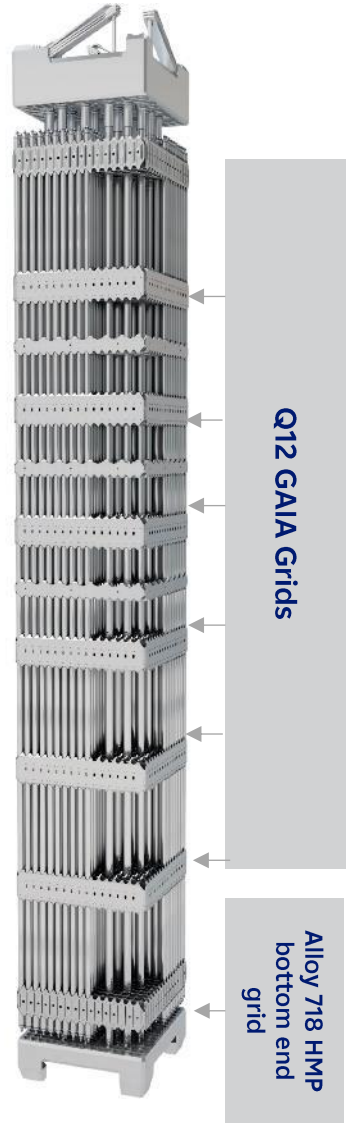
Line contacts on GAIA & HMP grids provide optimized fuel rod support conditions vs clad wear

Bottom nozzle: New Bullet Nose and placement of the water-hole pattern according to the rod lattice:

- Reduces trailing edge turbulence
- Protects against excessive fuel rod vibration







The combination of GAIA FA architecture, highly profiled bottom nozzle and 'line contact' type of rod support offered by GAIA design ensure a protection against

Property of Framatome © Framatome – All rights reserved

GAIA FA: First-class fuel reliability

Debris filtering performance



GRIP bottom nozzle has excellent debris filtering performance thanks to:

- **Reduced mesh size**
- **Position of the filter favorable for long debris**
- **Homogenous design without large ligaments which can redirect the debris**





GRIP bottom nozzle debris filtering efficiency is increased by 30% to 40% compared to previous generations

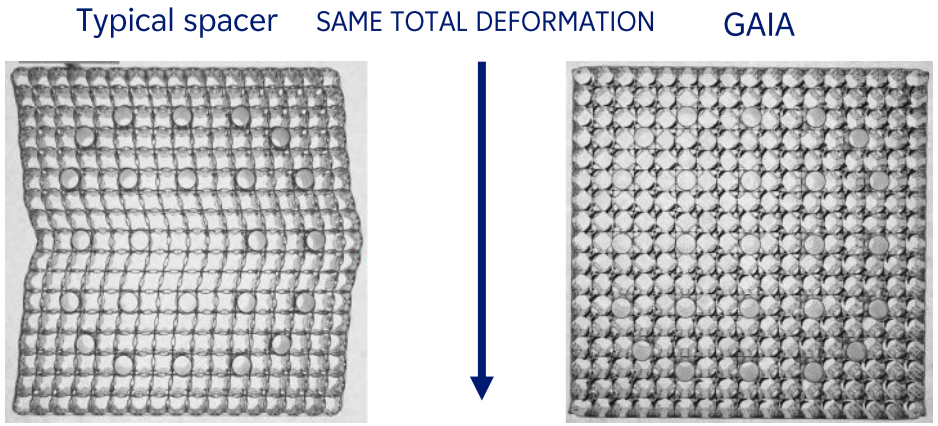
Property of Framatome © Framatome – All rights reserved

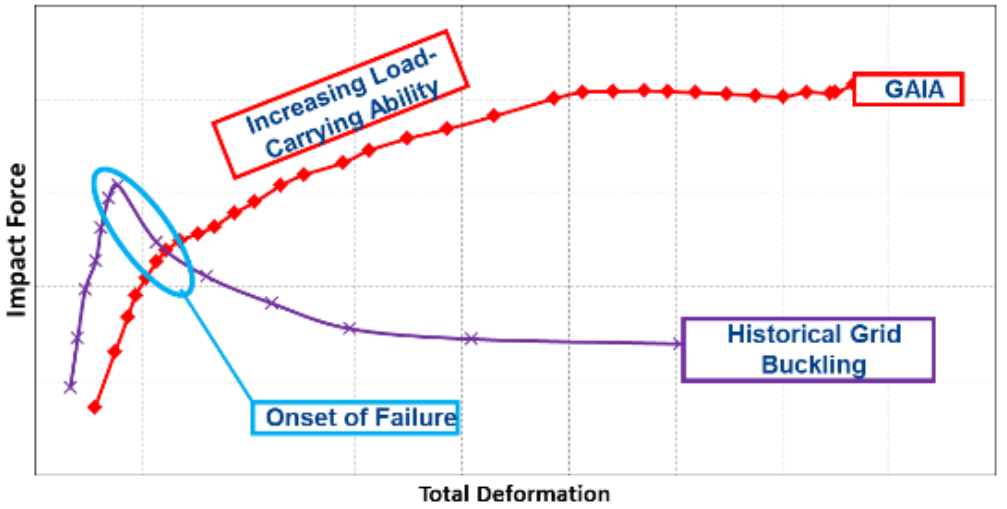
GAIA FA: Safety by Design

Accidental Conditions

GAIA grid has a non-critical compression failure mode**

- **Classical failure mode: critical buckling - instantaneous loss of load carrying capability, significant local deformations, loss of guide tube array**
- **GAIA failure mode: no loss of load-carrying capability, minimal local deformations, guide tube array maintained**







An Insurance against Increased Safety Requirements

** Studies performed with postulated accident loading

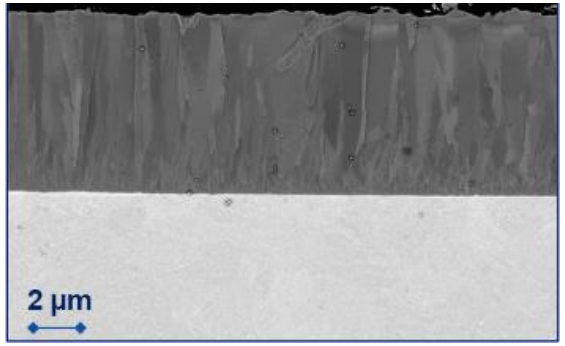
Property of Framatome © Framatome – All rights reserved

GAIA FA: Safety by Design

Framatome PROtect Enhanced Accident Tolerant Fuel (E-ATF) technology

E-ATF Cr-Coating (PROtect) option

- Dense & uniform coating
- Specifically optimized PVD process produces a highly protective and adherent coating while retaining key $M5_{Framatome}$ cladding properties
- High temperature corrosion resistance and ballooning / clad opening reduction in postulated LOCA





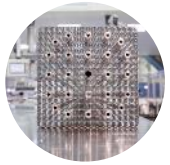
High-performance Fuel Rod featuring

$M5_{Framatome}$ Cladding

- Best in Class for Hydrogen Pick-up

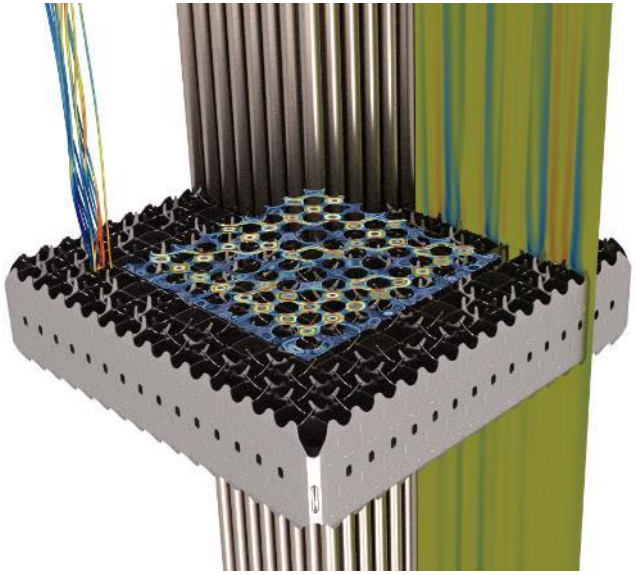


Property of Framatome © Framatome – All rights reserved



GAIA: Designed for Performance

Enhanced CHF performance vs Pressure loss

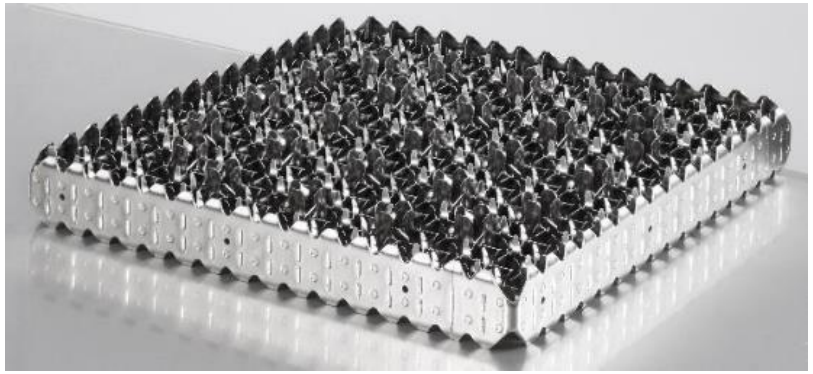


GAIA grid offers enhanced CHF performance

- Mixing vanes as in Advanced Mark BW / AFA 3G
- Vane pattern optimized
- CHF performance increased while spacer pressure loss decreased

Intermediate GAIA Mixer (IGM) Grid:

Based on AFA 3G design
Very high performance in combination with GAIA grid





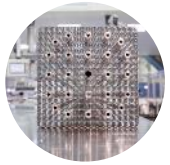
Property of Framatome © Framatome – All rights reserved

Fuel Assembly Bow



Marc Riboud

Property of Framatome © Framatome – All rights reserved

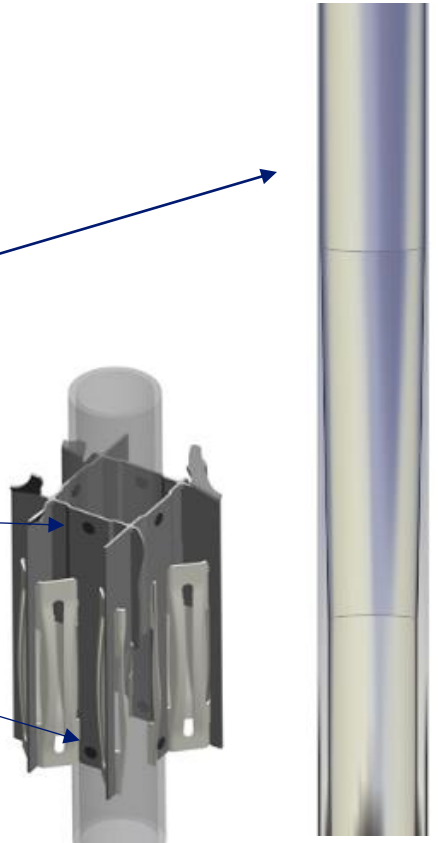


GAIA: Designed for Performance

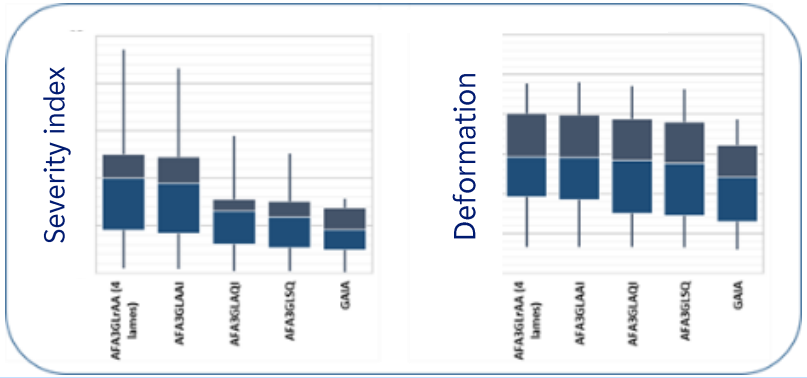
Fuel Assembly Bow

Superior resistance to deformation thanks to multiple FA distortion-resistant characteristics

- **MONOBLOC thick-walled guide tube (GT) outer diameter increased**
  - Increases cage lateral stiffness and reduces GT stresses
- **Incorporated (8 total) upper and lower GT welds**
  - Increases cage lateral stiffness (via rotational stiffness)
- **Choice of Q12 material for the guide tubes and the GAIA spacers**
  - Framatome advanced quaternary structural alloy with enhanced creep performance
  - Dimensional stability (low and predictable growth)

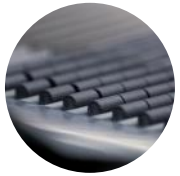


Performance vs lateral deformation in 1450 MWe reactors



GAIA product: a significant step to secure operations with respect to core distortion, in particular for 14ft reactors

framatome
026
Property of Framatome © Framatome - All rights reserved



GAIA: Designed for Operability

Ready for Advanced Fuel Management cycles







Objective

- Increased cycle length and Fuel burnup
- Reduced outage frequency

Licensing Progress

- Commercial implementation of GAIA in operating PWR fleets
- NRC approval of high burnup methodology supporting GAIA fuel
- Advanced codes and methods approved for enrichments above 5% U-235
- $M5_{Framatome}$ Cladding already licensed for 75GWd/MTU rod Average

LEU+ (>5% enrichment) Industrial Readiness

- Approval has been granted for the Richland manufacturing facility upgrades required for higher-enrichment fuel production
- 90% of facility modifications done for and will be finalized in 2027
- Industrial deployment targeted from 2027 onward

With GAIA, Framatome is leading the industry as the only AFM-ready supplier, delivering the first >5% enriched fuel reload to the market in Q1 2028

framatome

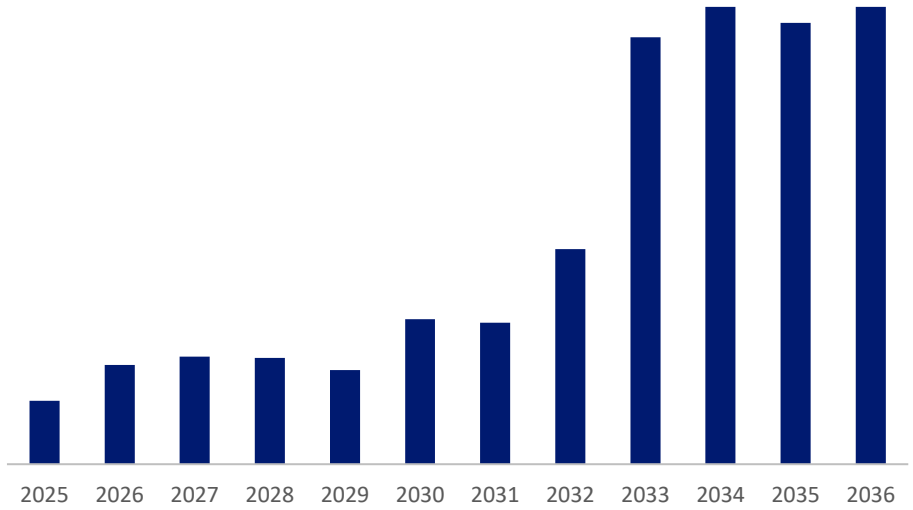
Property of Framatome © Framatome – All rights reserved

GAIA Experience and implementation

Deliveries:

- >20 GAIA reloads

Worldwide GAIA volumes (number of FA/Year)





Irradiation:

- >1200 GAIA Fuel Assemblies irradiated or being irradiated
- 7 reactors in operation with GAIA reload
- No rod failure
- Behavior in line with expectations

GAIA is Framatome new standard for 17x17 market

Property of Framatome © Framatome – All rights reserved

GAIA: Delivering Value to Utilities

A fuel assembly designed to address today and future operational challenges

- **Build on proven experience:**
  - Leveraging Framatome's extensive PWR fuel heritage
  - Combining proven technologies with selected innovations
- **Enhanced performance:**
  - Robust mechanical design
  - Strong thermal-hydraulic performance
  - Reliable fuel
- **Excellent operating experience, with zero fuel failures**
- **Ready for Advanced Fuel Management cycles**



Framatome’s GAIA fuel assembly enhances safety, reliability, and fuel economics in PWR

Property of Framatome © Framatome – All rights reserved



Contact

Dounia Lhachemi

dounia.lhachemi@framatome.com