

A FRAMATOME ANP

Preliminary Thermal Hydraulic Test Program for ATRIUM™12 Fuel Assembly

Dr. Jebelhack / Dr. Wehle / Dr. Wörzdörfer

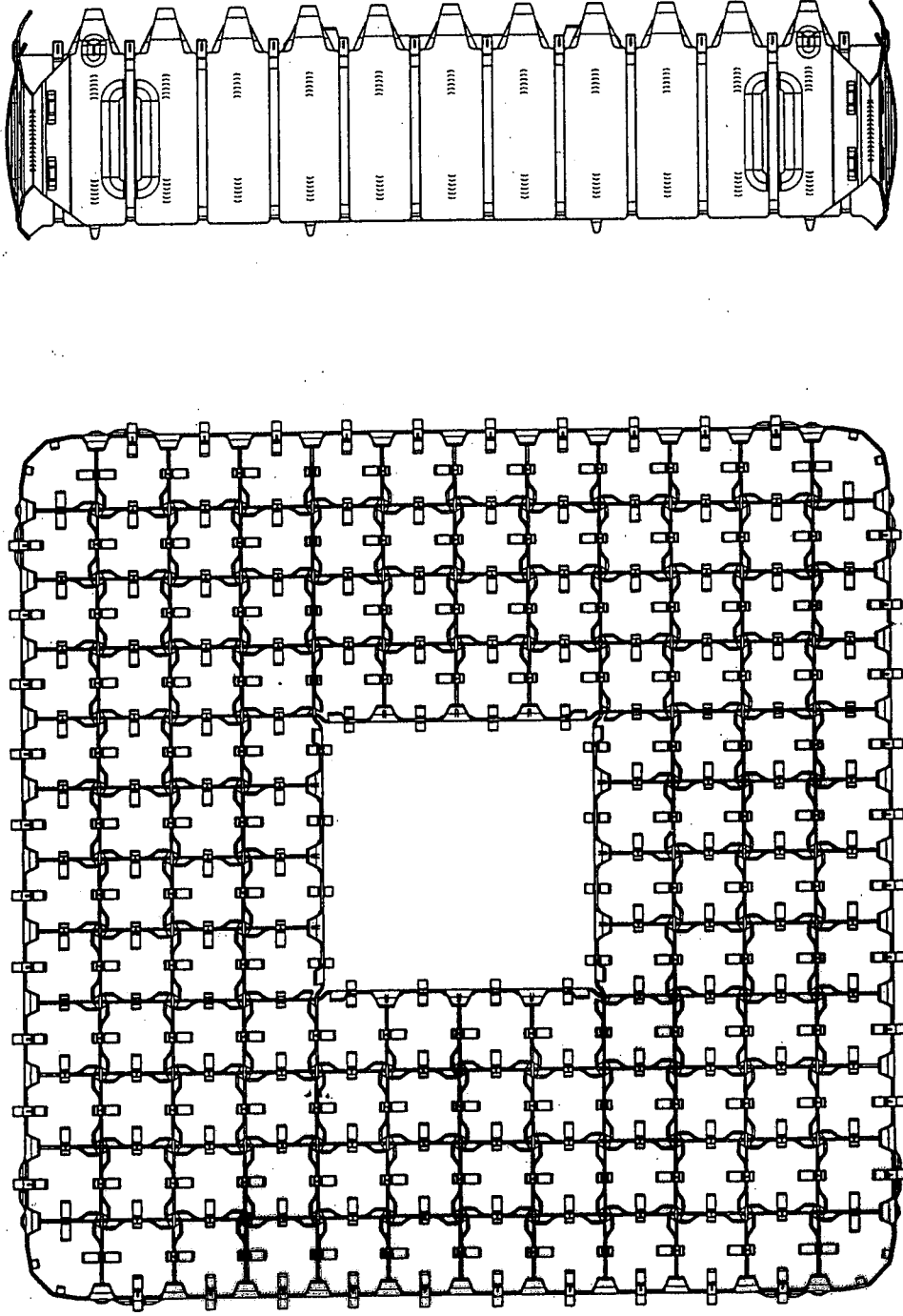
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***Preliminary Thermal Hydraulic Test
Program for SWR 1000 ATRIUM 12 Fuel
Assembly***



Spacer of ATRIUM 12 Fuel Assembly



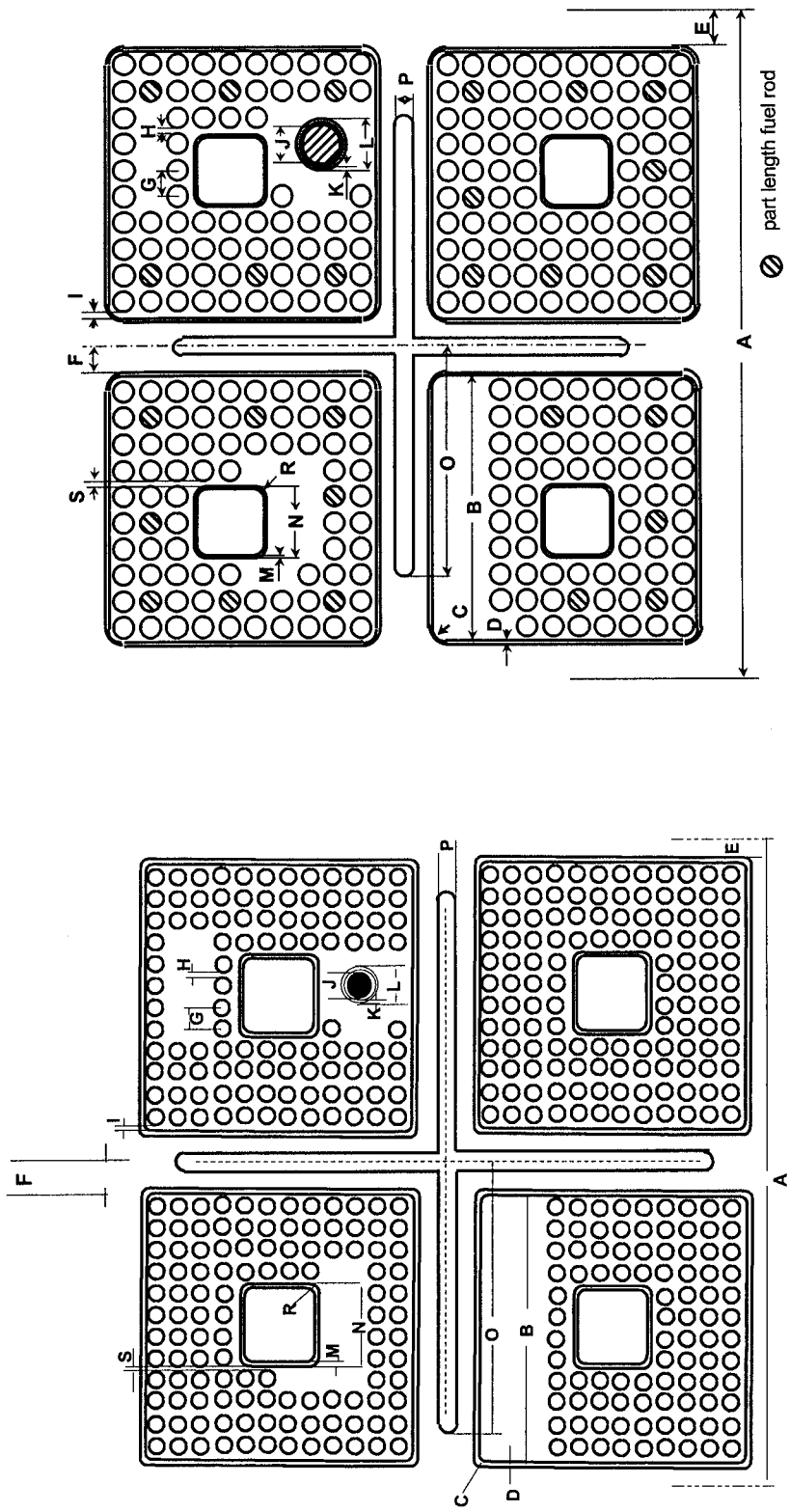
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Core Cell Geometry of SWR-1000 Compared to Conventional BWR



SWR 1000

Conventional BWR



Core Cell Geometry of SWC-1000 Compared to Conventional BWR

- > Fuel rod diameter, cladding thickness, pellet diameter, fuel rod pitch equal
- > Fuel channel side length + 16%
- > „Central“ water channel 4x4 compared to 3x3 ;
- > Control rod pitch + 19%
- > Control rod span +20%

SWR 1000 ATRIUM 12 Fuel Assembly

Preliminary Thermal Hydraulic Design

- > *Pressure Drop Performance*
 - *Loss Coefficients derived from ATRIUM 10A/B Loss Coefficients*
- > *Critical Power Performance*
 - *Modification of XL10A1 (Critical Power Correlation of ATRIUM 10A/B) due to expected Critical Power of ATRIUM 12 determined by Subchannel Analysis (RINGS)*
- > *Determination of Additive Constants*

Verification by KATHY Loop Measurements

ATRIUM 12 Fuel Assembly Test Bundle

> ***Original ATRIUM 12 FA geometry for critical power and pressure drop tests***

- ***same rod diameter***
- ***same rod pitch***
- ***same water channel geometry***
- ***same inner width of FA-Channel***
- ***same spacer and spacer pitch***

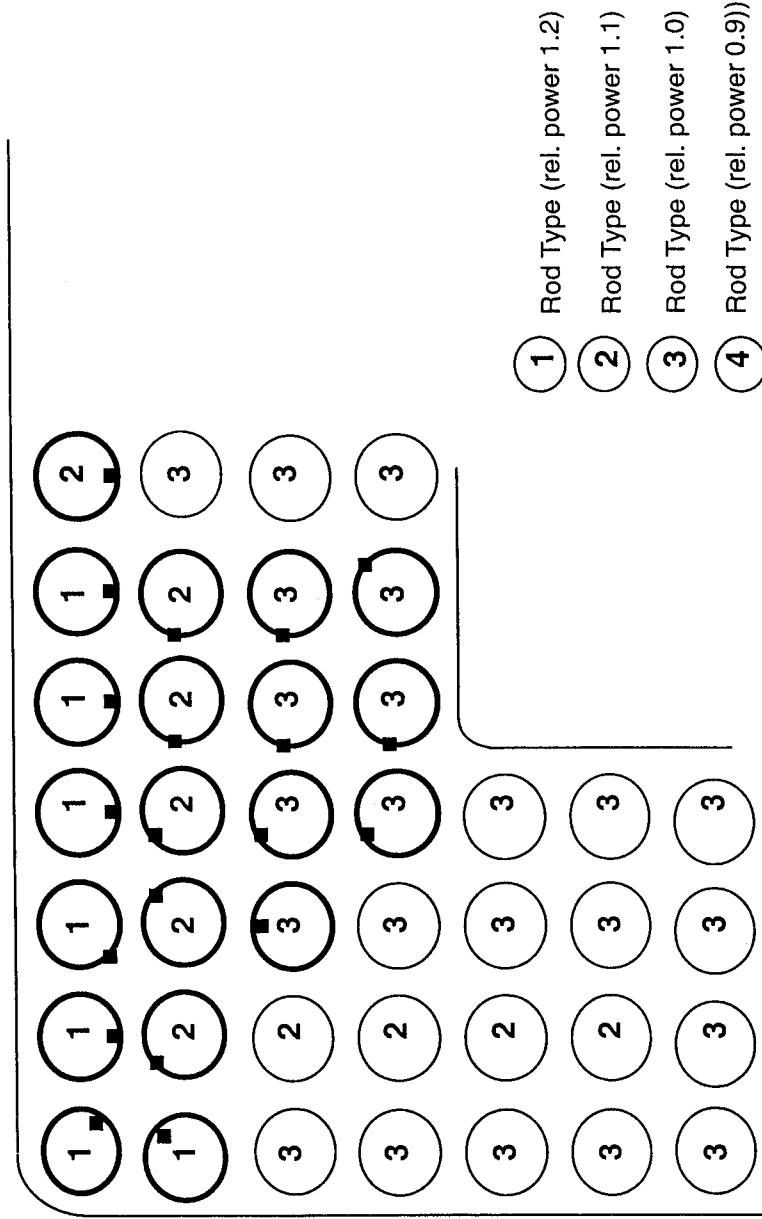
Axial power distribution for preliminary tests: chopped cosine

ATRIUM 12 Fuel Assembly Test Program

- > ***Critical Power Measurement as a Function of***
 - ***Fuel Assembly Flow (according to power flow map)***
 - ***Core inlet subcooling***
 - ***Pressure***
 - ***Radial Power Distribution (4 Peaking Patterns for preliminary tests)***

- > ***Measurement of Pressure Drop (single and two phase) as a
Function of***
 - ***Fuel Assembly Flow***
 - ***Bundle Power***

Peaking Pattern STS-85.7 with Cosine Shaped Axial Power Profile



all other rods are of type 4

SWR 1000 ATRIUM 12 Fuel Assembly

Determination of Thermal Hydraulic Performance

- > **Critical Power**
- > *Establish preliminary critical power correlation (XL-Type) based on test results*
- > *Derive K-Factors (R-Factors) for critical power correlation*
- > *Determine additive constants*
- > **Pressure Drop**
- > *Determine spacer loss coefficient based on test results*