AREVA

RLBLOCA Rev. 2 Update Meeting

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C. K. Nithianandan

Ken Carlson

Eric Coryell

NRC Rockville, May 19, 2009

> **Introduction – Bert Dunn**

> **Rod to Rod Radiation Model Description and Benchmarks – Scott Franz, C. K. Nithianandan**

> **Dispersed Flow Film Boiling Model and HTC Benchmarks – Ken Carlson**

> **Methodology Nodalization Studies – Eric Coryell**

> **Summary of methodology changes – Scott Franz**

> **Open Discussion and Conclusion**

Rod to Rod Radiation Model

Scott Franz
Manager
LOCA & ECCS Analysis
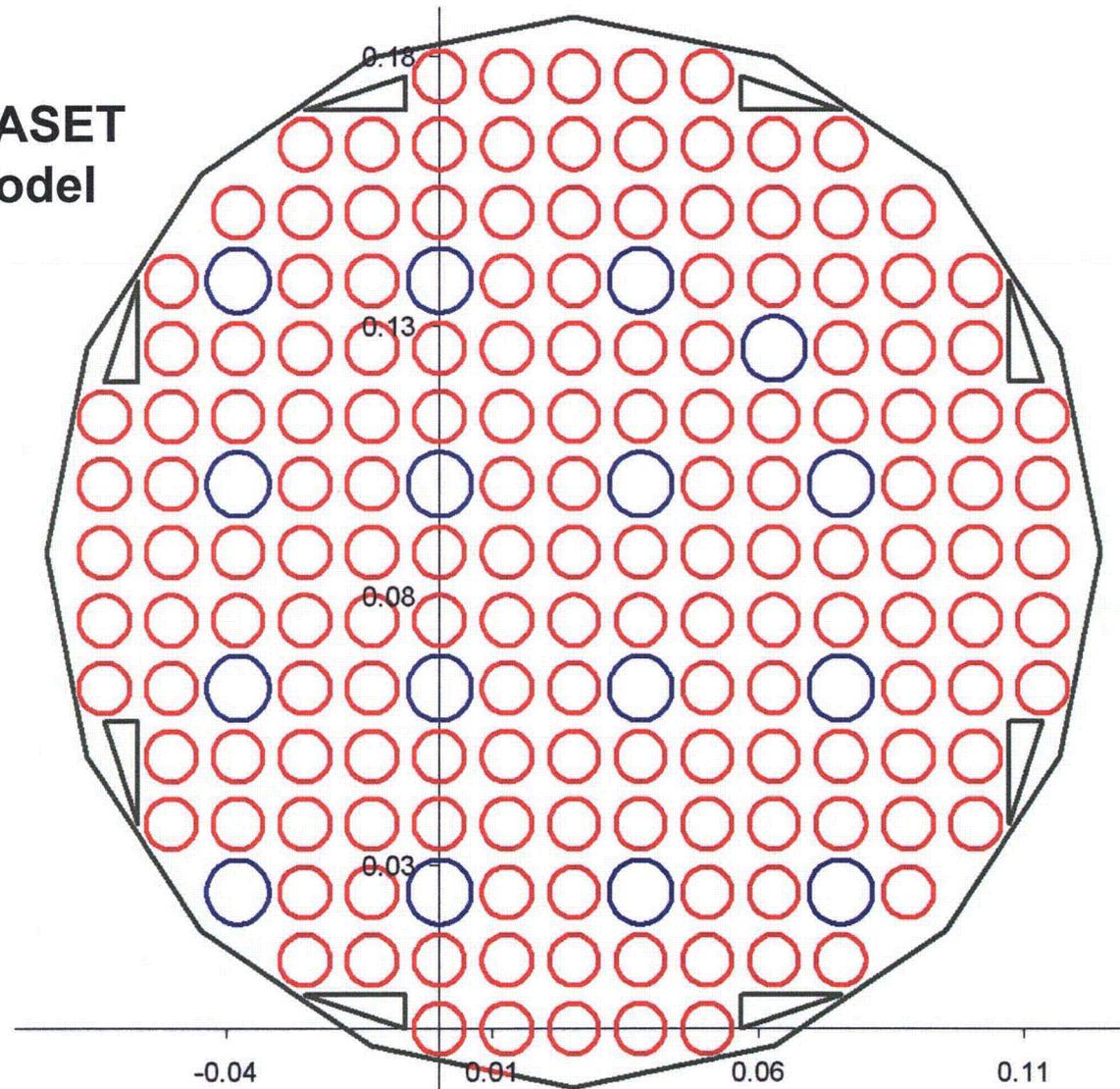**AREVA NP Inc.**
Lynchburg

Rod to Rod Radiation

> **Review**

 ◇ **In order to separate the components of heat transfer, the radiation viewfactors between the contributing heat transfer structures needs to be generated**

 ◇ **AREVA has developed a ray tracing technique to model 2D viewfactors**

  ° **Core Barrel and supporting structures**

  ° **Guide Tubes**

  ° **Heater Rods**

 ◇ **A rod temperature distribution across the FLECHT-SEASET bundle is also needed**

  ° **The distribution provides information as to how the radiation component for rods changes across the bundle**

  ° **A representation for uninstrumented rod temperatures is needed to compute radiation contributions from instrumented rods**

> **FLECHT-SEASET**
> **Radiation Model**

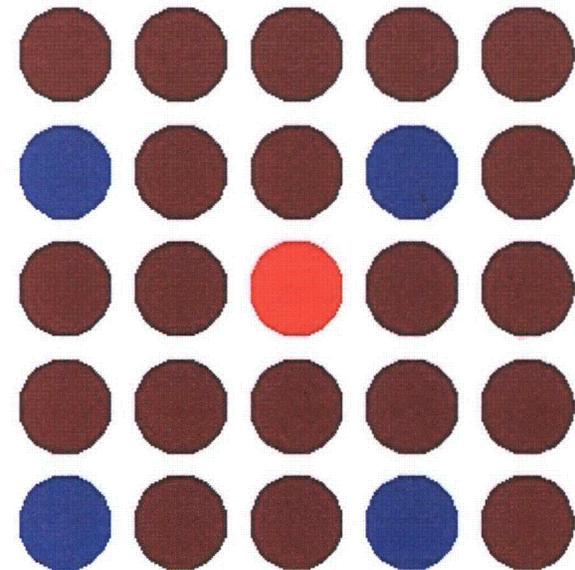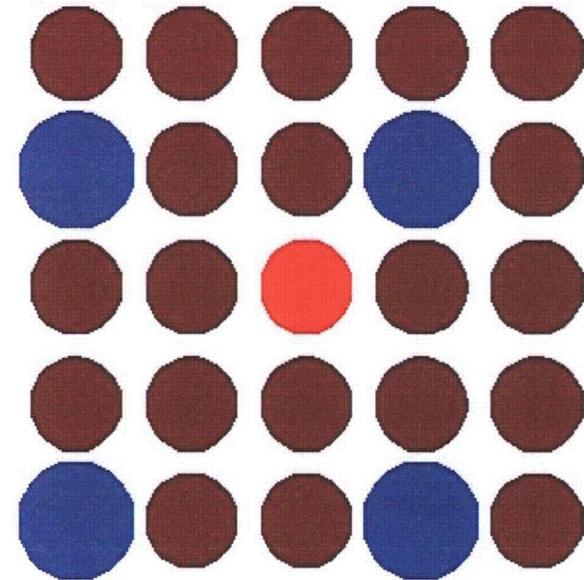# Rod to Rod Radiation

Rod to Rod Radiation

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Rod to Rod Radiation

> **Model Validation (All results are preliminary, no QA has been performed)**

  ◆ **Comparisons to Len Ward model**

  • **Comparison 1**

    – **Used temperature distributions provided**
    – **All rods same diameter**
    – **No radiation to fluid**

♦ **Comparisons to Len Ward model (cont.)**

- **Comparison 2**
  - Same as comparison 1 but correct guide tube diameter used
- **Comparison 3**
  - Same as comparison 2 but rod to steam and rod to liquid added

Rod to Rod Radiation

Rod to Rod Radiation

Rod to Rod Radiation

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> **Outlined squares show instrumented rods**

> **Blue squares show guide tubes**

> **All temperatures in Fahrenheit**

> **Represents FLECHT-SEASET 31504, 6' elevation at 100s**

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	720	720	720	720	720	1808	1852	1857	1852	1808	720	720	720	720	720
2	720	720	720	1815	1863	1909	1934	1950	1936	1909	1865	1817	720	720	720
3	720	720	1832	1901	1933	1943	1956	1960	1968	1947	1939	1906	1841	720	720
4	720	1806	1750	1961	1952	1750	1961	1963	1750	1951	1951	1924	1906	1817	720
5	720	1855	1933	1958	1962	1906	1966	1969	1965	1954	1750	1951	1939	1865	720
6	1800	1893	1939	1961	1965	1979	1971	1971	1959	1963	1957	1952	1947	1910	1809
7	1843	1834	1750	1963	1966	1750	2023	1972	1750	2032	1970	1750	1957	1941	1856
8	1849	1924	1952	1966	1969	1971	1976	1975	1973	1975	1974	1968	1967	2031	1864
9	1846	1924	1972	1966	1969	1970	1976	1979	1974	1972	1972	1995	1963	1941	1856
10	1805	1897	1750	1962	1966	1750	1976	2074	1750	1968	1967	1750	1946	1911	1809
11	720	1856	1931	1959	1965	1967	1974	1976	1971	1968	1965	1954	1933	1864	720
12	720	1813	1908	1973	1959	1962	1967	1967	1965	1962	1958	1952	1901	1815	720
13	720	720	1750	1908	1931	1750	1952	1952	1750	1940	1933	1750	1831	720	720
14	720	720	720	1813	1856	1896	1923	1926	1869	1895	1855	1806	720	720	720
15	720	720	720	720	720	1805	1847	1850	1845	1802	720	720	720	720	720

> Final calculations for the determination of R2R radiation contribution will be completed very soon

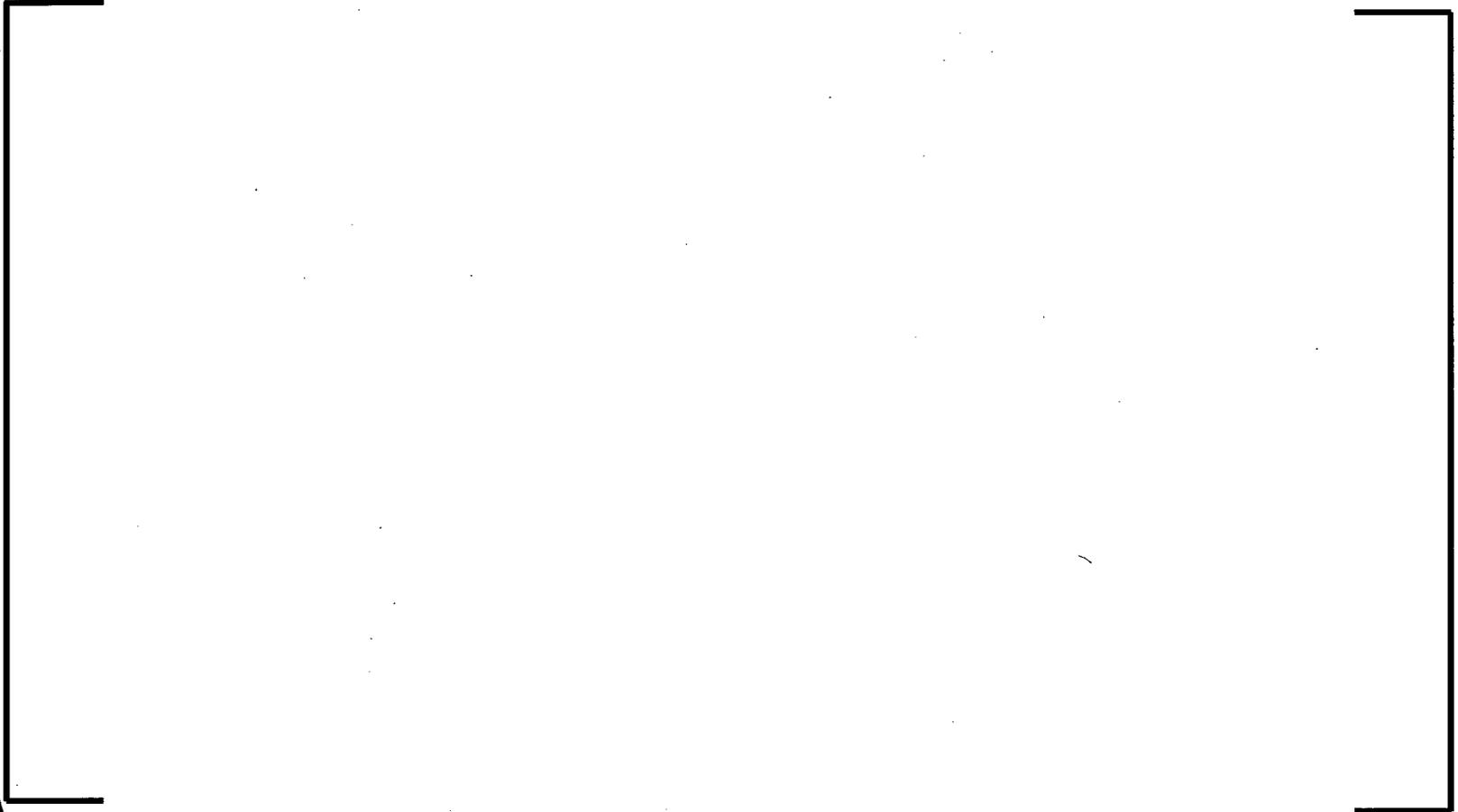> Preliminary values are currently being used for Dispersed Flow Film Boiling convective heat transfer development

SRELAP5 Modifications

Ken Carlson
Advisory Engineer
Safety Analysis Methods
AREVA NP Inc.
Richland

> **Application Strategy**

> **Preliminary Multiplier Determination**

> **Revised DFFB model**

> **Radiation Heat Transfer**

> **Preliminary Benchmarks**

> **Summary of Remaining Tasks**

SRELAP5 Modifications
Application Strategy

SRELAP5 Modifications
Application Strategy

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SRELAP5 Modifications
Revised DFFB Model

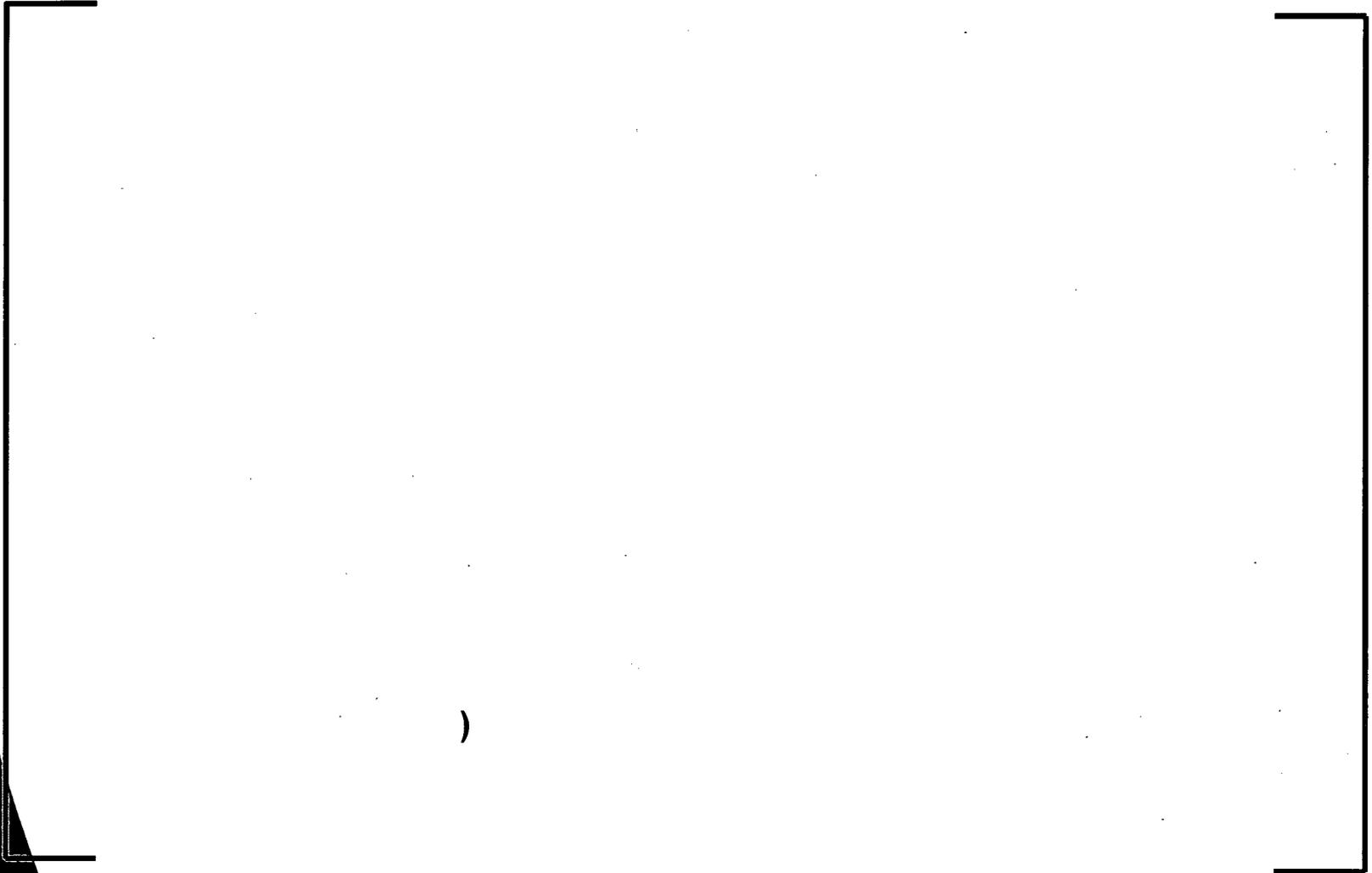# SRELAP5 Modifications
Summary of Remaining Tasks

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Methodology Nodalization

Eric Coryell
Principal Engineer
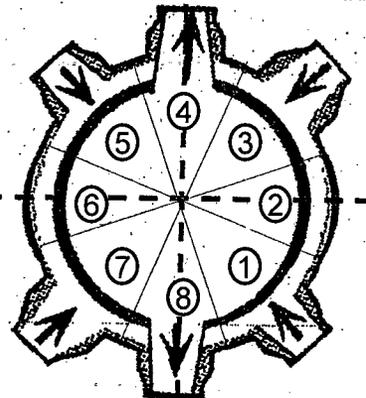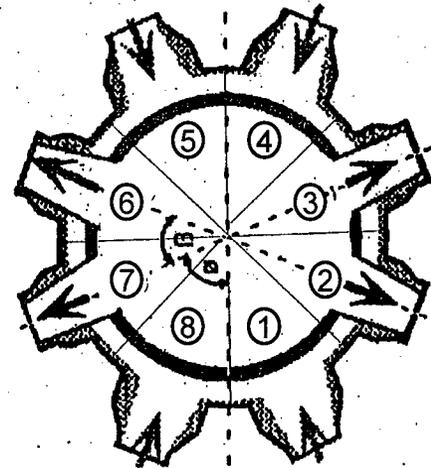*LOCA & ECCS Analysis*
AREVA NP Inc.
Lynchburg
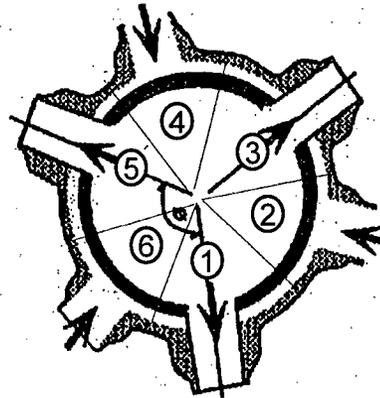
> **CSAU Methodology Development Suggests**
>
> ◇ **"The plant model must be nodalized finely enough to represent both the important phenomena and design characteristics of the [Nuclear Power Plant] but coarsely enough to remain economical."**
>
> ◇ **"Thus, the preferred path is to establish a standard [Nuclear Power Plant] nodalization for the subsequent analysis. This minimizes or removes nodalization, and the freedom to manipulate noding, as a contributor to uncertainty."**
>
> ◇ **"Therefore, a nodalization selection procedure defines the minimum noding needed to capture the important phenomena."**
>
> ◇ **"This procedure starts with analyst experience in previous code assessment and application studies and any documented nodalization studies. Next, nodalization studies are performed during the simulation of separate- and integral-effects code data comparisons. Finally, an iterative process using the [Nuclear Power Plant] model is employed to determine sufficiency of the NPP model nodalization."**
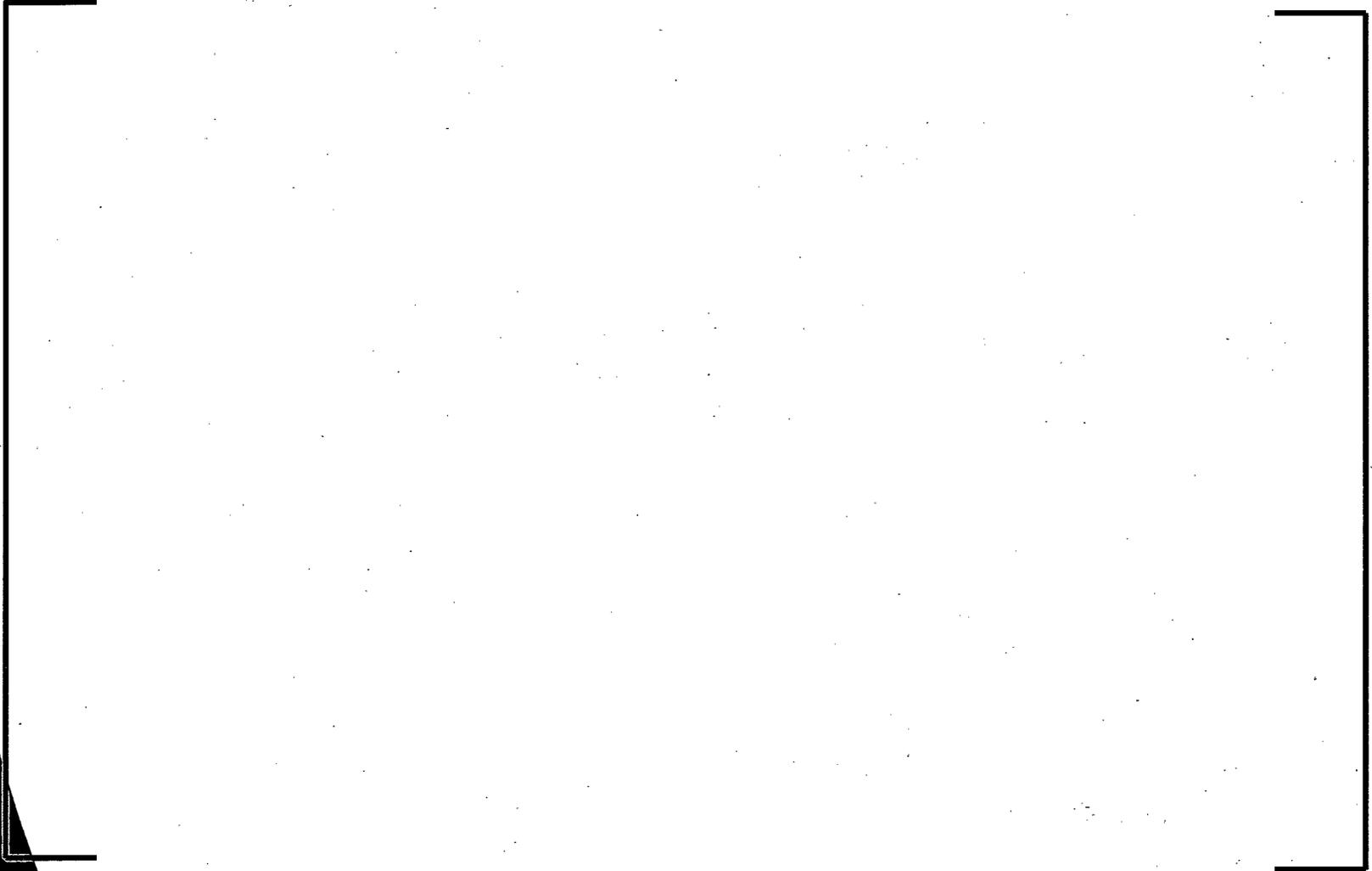
Methodology Nodalization

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Methodology Nodalization

Methodology Nodalization

Methodology Nodalization

Methodology Nodalization

Summary of Methodology Improvements

> **Rod to Rod Radiation**

> **New Dispersed Flow Film Boiling Correlation**

> **New Nodalization**

> **Clarification of the Containment Methodology**

> **Introduction of COPERNIC 2 - Advanced Fuel Performance Code**

> **Beyond First Cycle Analysis**

> **EMDAP Documentation - Reg. Guide 1.203**

Open Discussion and other Points of Interest

> **NRC Commentary**

   ◇ **Comments on current Revision 2 Scope**

   ◇ **Potential emerging issues**

> **General Discussion**