UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

November 13, 1989

Docket No. 50-267

MEMORANDUM FOR: Seymour H. Weiss, Director
Non-Power Reactor, Decommissioning and
Environmental Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects

FROM: Peter B. Erickson, Project Manager
Non-Power Reactor, Decommissioning and
Environmental Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects

SUBJECT: SUMMARY OF MEETING WITH PUBLIC SERVICE COMPANY OF COLORADO (PSC) TO DISCUSS FORT ST. VRAIN (FSV) REACTOR DEFUELING (TAC NO. 73125)

Introduction

This meeting was requested to further discuss issues connected with FSV reactor defueling. The attendees at this meeting are listed in Attachment 1. The material presented by PSC is provided in Attachment 2. Attachment 3 is the PSC report EE-DEC-0022 Rev B concerning the neutron count rate analysis discussed herein.

Current Status of Defueling and Decommissioning

PSC's plans to defuel FSV are currently uncertain because their ability to ship fuel offiste in the near future is potentially not available. PSC only has limited (one third of core) capacity for fuel storage on-site. Long term resolution of this problem, including the options of construction of on-site storage, may take several years.

However, PSC is ready to initiate the defueling operation with the intent of placing the core in a safer configuration. The fuel handling machine (FHM) has been refurbished. It will be modified shortly to work with a personal computer interim control system. An upgraded control system is also being developed. PSC has on-site sufficient dummy fuel blocks and poison pin material and new metal plenum elements to start the reactor defueling.

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49-21101

DF01
1/1

Alternative plans for decommissioning are also being evaluated which are different from the preliminary decommissioning plan submitted to the staff. They involve an early dismantlement option. A final decision on this option will be made during the summer of 1990.

Defueling Count Rates

PSC reviewed their analysis of expected defueling count rates. (See Attachment 3). The PSC analysis is based on a complex model evaluation with the model being calibrated against data from earlier refuelings. The key factor in assuring an adequate count rate is the ability to add new neutron sources to the core. Additionally, boronated material between the core and the detector can be removed and replaced with equivalent non boronated material. PSC's analysis shows an adequate count rate will be maintained at the detectors. The calculations were independently reviewed by PSC and by GA Technologies.

Other Defueling Issues

It was agreed that PSC could resolve the issue of a rod withdrawal accident by further discussion of their administrative controls. The goal of this discussion would be to demonstrate that a rod withdrawal accident was not a credible event, since strict controls were maintained over the control rod drive mechanism power sources.

The reserve shutdown system (RSS) was also discussed. PSC agreed to provide calculations showing how the RSS could deal with credible reactivity control problems arising from failures of the control rod drives. PSC response to these issues was received on November 6, 1989.

Other Defueling Sequences

PSC discussed their preliminary evaluation of other defueling sequences. These sequences would involve removing the most reactive core segments to the fuel storage wells. At that point the balance of the core could be demonstrated to be subcritical with k(eff) less than 0.95 with all rods withdrawn. PSC was still evaluating these alternatives at this time.

Other Issues

PSC informed the staff that they were making changes to certain qualified equipment under their equipment qualification program. Generally, this would mean that certain equipment no longer needed for safe operation would not have its qualifications maintained. It was agreed that PSC would provide the staff with an information letter covering this issue.

In Addition, PSC was planning to make certain changes to the plant's safe shutdown systems that are required under 10 CFR Part 50, Appendix R. PSC proposed to meet with the staff at the plant site to discuss these changes. A meeting has been scheduled for November 16, 1989 at Fort St. Vrain.

Original signed by:

Peter B. Erickson, Project Manager
Non-Power Reactor, Decommissioning and
Environmental Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects

Attachments:
As stated

cc w/attachments:
See next page

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| J. Sharkey | T. Westerman | D. Fieno | L. Kopp |

OFC/1/1

| OFC | :PDNP:LA | :PDNP:PM | :PDNP:PD | : | : | : | : : |
|---|---|---|---|---|---|---|---|
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In Addition, PSC was planning to make certain changes to the plant's safe shutdown systems that are required under 10 CFR Part 50, Appendix R. PSC proposed to meet with the staff at the plant site to discuss these changes. A meeting has been scheduled for November 16, 1989 at Fort St. Vrain.

Peter B Erickson

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Attachments:
As stated

cc w/attachments:
See next page

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Attachment 1

# Attendees at
# PSC/NRC Meeting
# October 25, 1989

| NAME | ORGANIZATION |
|---|---|
| K. L. Heitner | NRC/NRR |
| D. Alberstein | General Atomics |
| H. L. Brey | PSC |
| Don Warembourg | PSC |
| Richard Nirschl | PSC |
| Russell Sherman | PSC |
| M. H. Holmes | PSC |
| T. F. Westerman | NRC/RIV |
| Daniel Fieno | NRC/SRXB |
| Larry Kopp | NRC/SRXB |
| Pete Erickson | NRC/NRR |
| Seymour Weiss | NRC/NRR |

Attachment 2

MEETING AGENDA
NRC/PSC MEETING 10-25-89

I. INTRODUCTION

- INTRODUCTORY REMARKS, PSC
- MEETING OBJECTIVES
- INTRODUCTORY REMARKS, NRC

II. CURRENT STATUS

III. COUNT RATE ENGINEERING EVALUATION

OVERVIEW

DISCUSSION

IV. NRC QUESTIONS ON DEFUELING SAR

V. DEFUELING/ALTERNATIVES

VI. OPEN DISCUSSION

NRC MEETING
OCTOBER 25, 1989

- MEETING OBJECTIVES
  - PROVIDE DEFUELING STATUS
  - RESOLVE COUNT RATE ISSUE, EXISTING SAR
  - CLARIFY AND ESTABLISH APPROACH AND LOGISTICS NRC QUESTIONS ON DEFUELING SAR
  - OBTAIN NRC INPUT/THOUGHTS ON DEFUELING ALTERNATIVES

## PRESENT STATUS
## DEFUELING ISSUES

- MEETING, DOE/GOVERNOR ANDRUS (SEP 9, 1989)
  - EXPRESSION OF CONCERN ABOUT FSV FUEL
- GOVERNOR ANDRUS LETTER (SEP 15, 1989)
  - ACCEPTANCE OF ANY FSV FUEL FOR LONG TERM STORAGE IN IDAHO IN JEOPARDY
- PSC CEO/VP NUCLEAR OPERATIONS MEETING WITH COLORADO GOVERNOR SEP 29, 1989
- PSC MEETING INTERNAL (OCT 2, 1989)
  - DISCUSS/DEFINE STRATEGY AND ALTERNATIVES
- PSC/WINCO MEETING ICPP (OCT 6, 1989)
  - READINESS OF GRAPHITE STORAGE FACILITY (GSF)
- MEETING DOE/GOVERNOR ANDRUS (OCT 11, 1989)
  - FSV FUEL SHIPMENTS TO ICPP STILL IN JEOPARDY
  - WHITE PAPER IN PREPARATION
- MEETING PSC/SECRETARY WATKINS STAFF
  - PSC CEO & VP NUCLEAR OPERATIONS TO MEET WITH UNDER SECRETARIES
- MEETINGS WITH GOVERNOR'S STAFF AND STATE REPRESENTATIVES ON TRANSPORTATION, SHIPPING AND ISFSI

## PRESENT STATUS
## DEFUELING/DECOMMISSION/CONVERSION

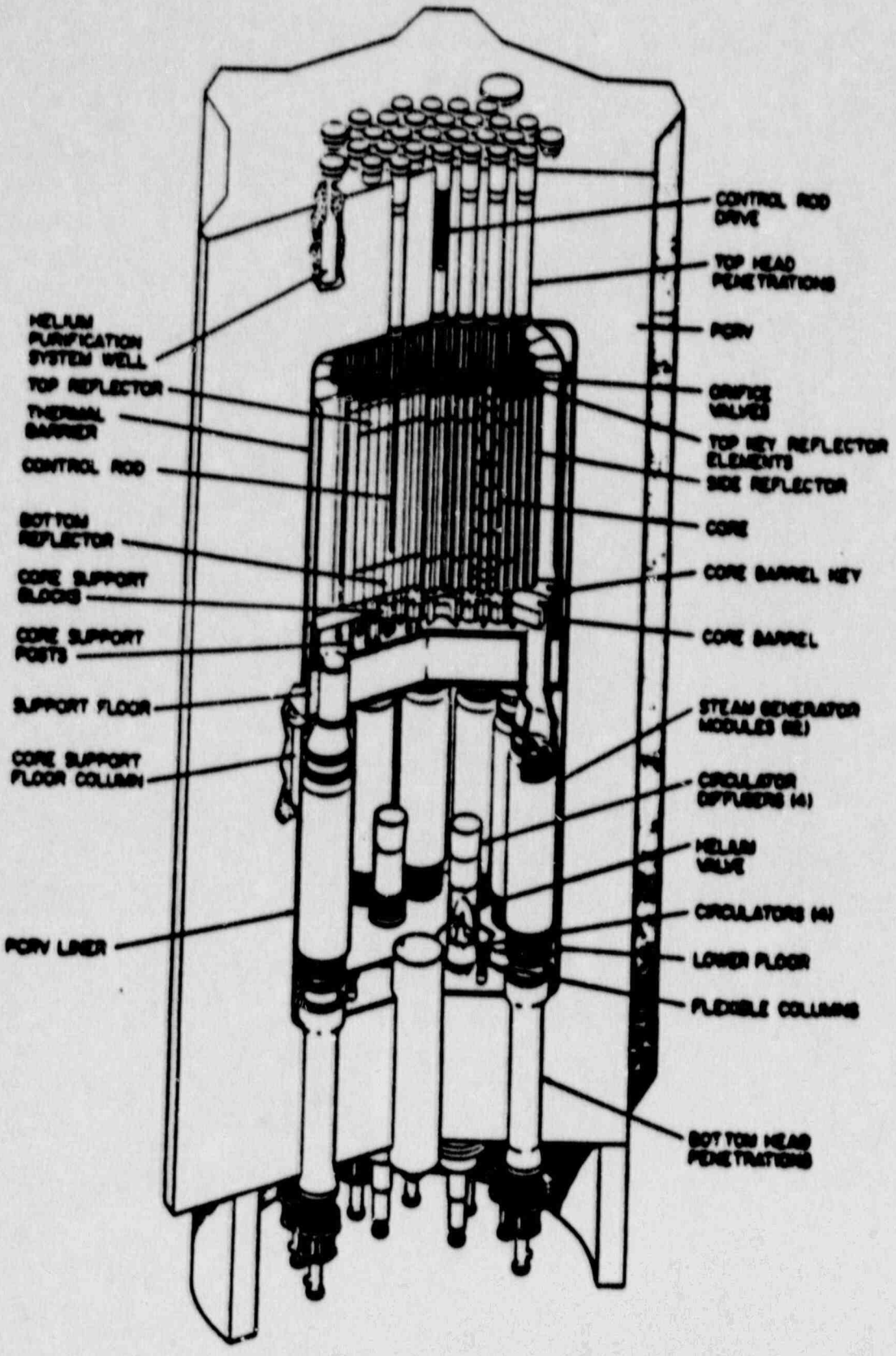
- PSC WORKING FUEL DECK PREPARATIONS AND MODIFICATIONS TO BEGIN DEFUELING ON OR ABOUT NOV 27, 1989
- FUEL HANDLING MACHINE UPGRADES IN PROGRESS
- SUFFICIENT DUMMY BLOCKS ON SITE TO BEGIN DEFUELING
- METAL PLENUM ELEMENTS (NON BORONATED) EXPECTED ON SITE IN EARLY NOVEMBER
- DEFUELING SAR AND NECESSARY TECHNICAL SPECIFICATIONS HAVE BEEN SUBMITTED TO NRC
- FIRST ROUND OF QUESTIONS ON THE PRELIMINARY DECOMMISSIONING PLAN IN WORK FOR DEC 1 RESPONSE
- REQUEST FOR PROPOSAL FOR EARLY DISMANTLE AND CONVERSION IN FINAL REVISION FOR ANTICIPATED BID SOLICITATION LAST WEEK IN NOV, 1989
- FIRST ISFSI MEETING WITH NRC ON OCT 13, 1989. WORK IN PROGRESS FOR DESIGN, SAR AND ENVIRONMENTAL ASSESSMENT FOR SIX SEGMENT ISFSI WITH OPTION TO REDUCE TO ONE SEGMENT ISFSI

# THE PROBLEM

MAINTAIN ADEQUATE START-UP CHANNEL COUNT RATE DURING FSV DEFUELING UNTIL THERE IS NO LONGER A CREDIBLE MEANS OF ACHIEVING CORE CRITICALITY

FIGURE 1

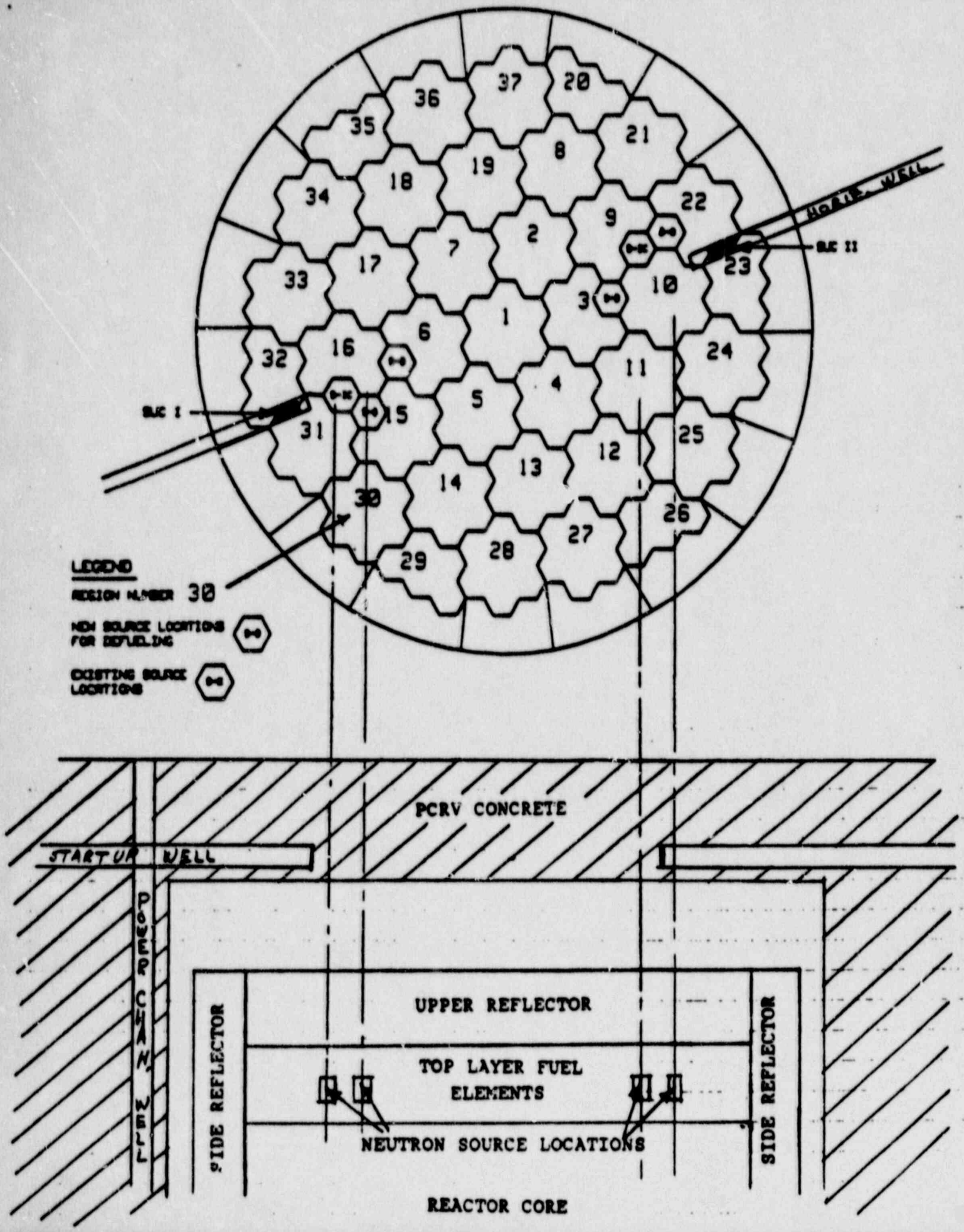
Fort St. Vrain Reactor Arrangement



# KEY ELEMENTS OF THE EXISTING FSV START-UP CHANNEL DETECTOR SYSTEM

- TWO SOURCE RANGE NEUTRON DETECTORS LOCATED IN PENETRATION WELLS WITHIN THE UPPER PCRV CONCRETE.
- CF-252 NEUTRON SOURCES LOCATED IN THE TOP LAYER OF FUEL IN THE CORE, CREATING A SHUTDOWN MODE COUNT RATE OF AT LEAST 4.3 COUNTS/SECOND IN EACH DETECTOR.

FSV NEUTRON SOURCE and STARTUP DETECTOR CONFIGURATION

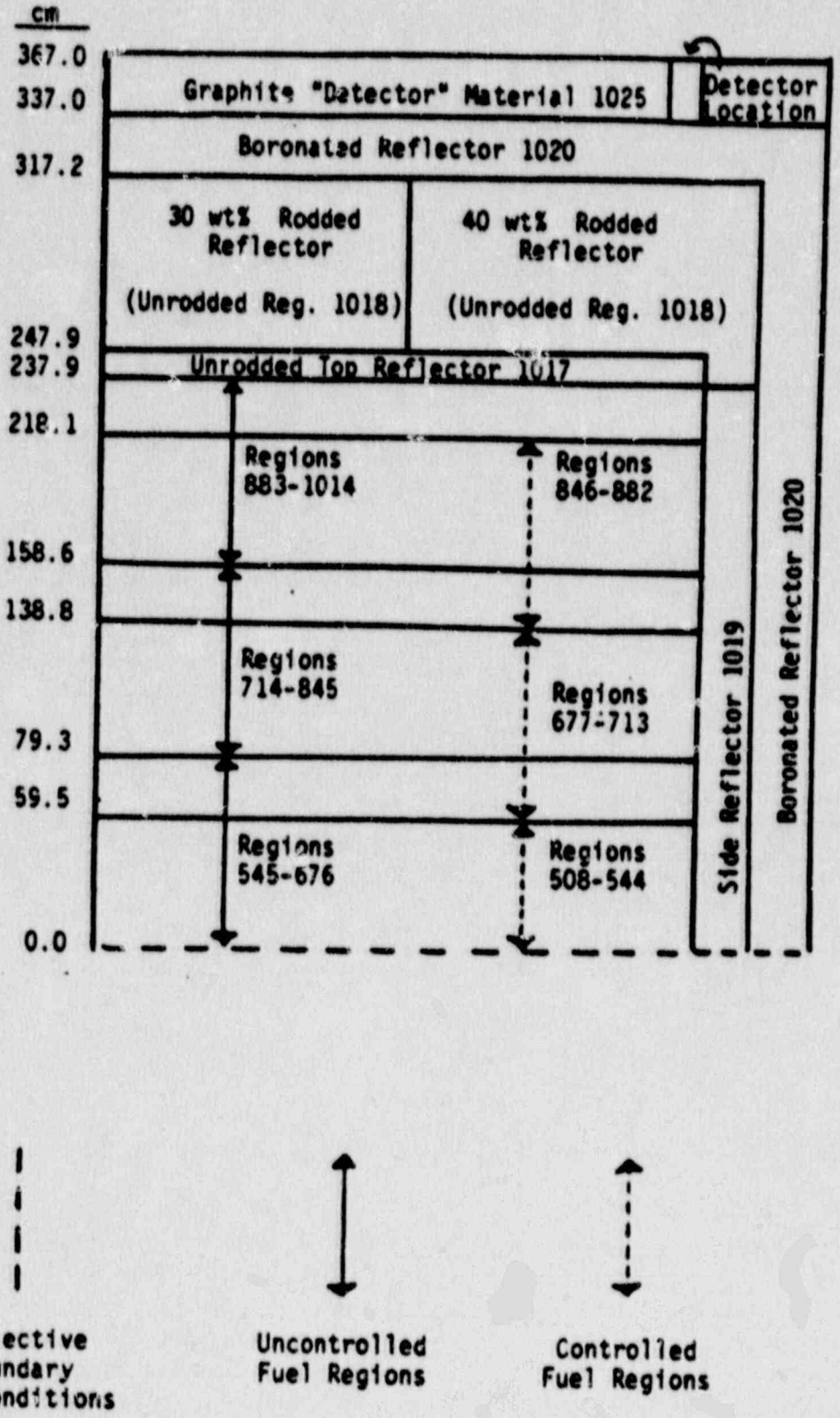


# THE FSV NEUTRON SOURCE DIF3D ANALYTICAL MODEL

- BASED UPON AN EXPLICIT 1/2 CORE 3-D DIFFUSION MODEL OF THE FSV ACTIVE CORE AND UPPER REFLECTORS
- UTILIZES THE INHOMOGENOUS INTRINSIC NEUTRON SOURCE OPTION OF DIF3D
- DETECTOR COUNT PREDICTIONS ARE BASED UPON EXPERIMENTAL BENCHMARKS

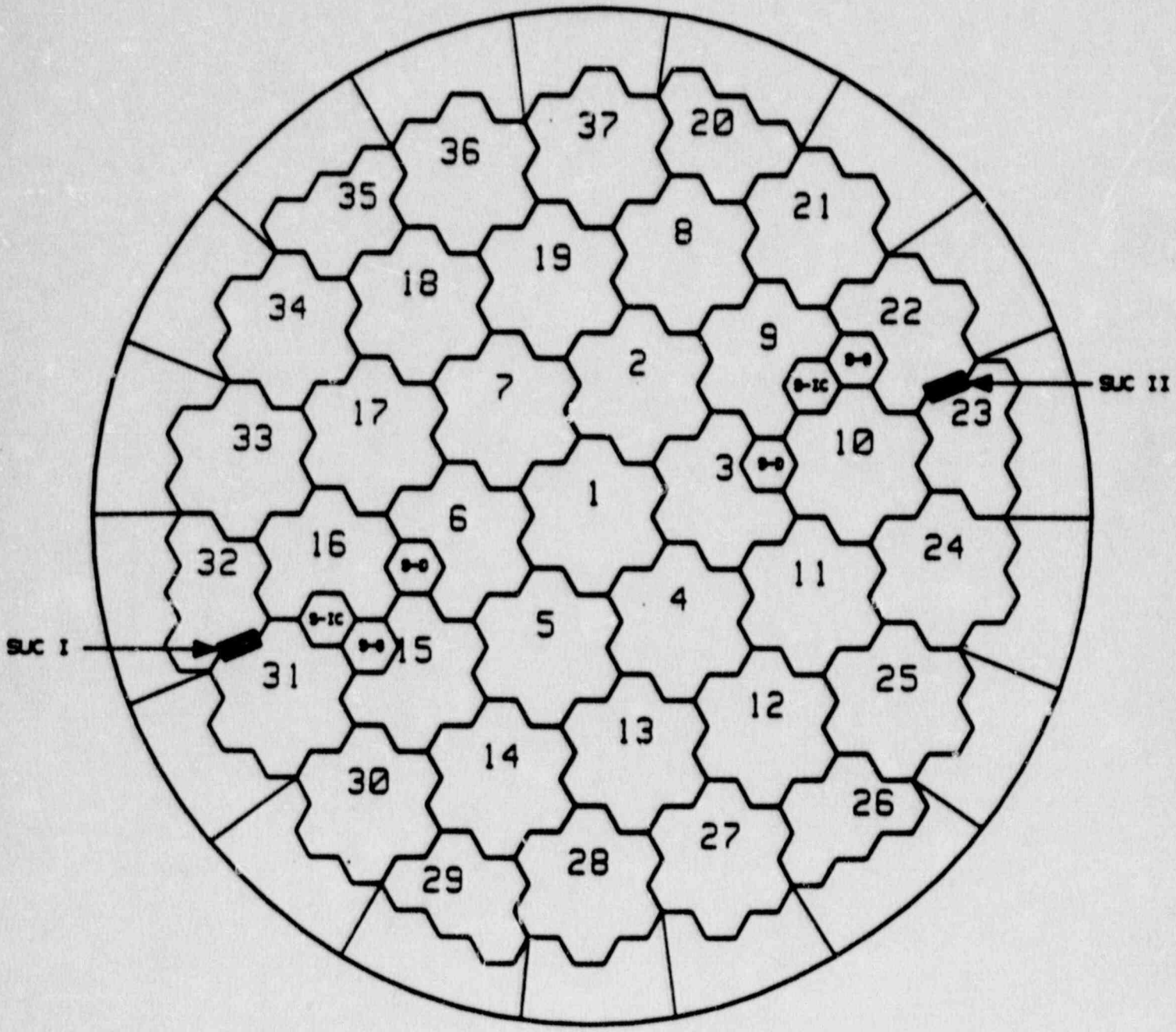
Figure III.1

3-D 1/2 Core DIF3D FSV Model
for Detector/Source Analysis



# PROPOSED NEUTRON SOURCE LOCATIONS TO SUPPORT FSV DEFUELING OPERATIONS

Figure III.3




LEGEND

REGION NUMBER 30

NEW SOURCE LOCATIONS FOR DEFUELING

EXISTING SOURCE LOCATIONS

Table IV.1

Startup Channel Count Rate Data From
the FSV Third Refueling

1) Surveillance Data

| Core Configuration | SUC1 (CPS) | SUC2 (CPS) |
|---|---|---|
| Initial (Prior to Refueling) | 31.5 | 7.3 |
| Prior to Refueling Reg 3 | 32.0 | 7.9 |
| Prior to Refueling Reg 22 | 31.3 | 7.9 |
| Prior to Refueling Reg 18 | 32.2 | 52.6 |
| Prior to Refueling Reg 29 | 34.3 | 56.1 |
| Prior to Refueling Reg 3 | 34.6 | 56.8 |
| Prior to Refueling Reg 33 | 37.5 | 57.0 |
| Final (After Refueling) | 35.0 | 56.0 |

2) Strip Chart Data

| Core Configuration | SUC1 (CPS) | SUC2 (CPS) |
|---|---|---|
| After Source placed in Reg 22, Two Layers of Reflector Blocks added but no Plenum Blocks or CRD in Reg 22 | Not Available | 1600 |
| After Source placed in Reg 22, Top Reflector and Plenum put back, no CRD in Reg 22 | Not Available | 320 |
| After Source placed in Reg 22, Top Reflector, Plenum and CRD put back in Reg 22 | Not Available | 90 |

Table IV.2

Detector Response Comparisons for
1/2 Core DIF3D vs Experimental Data

1) Surveillance Data: All Regions Refueled, After Source in Region 22

| | SUC1 | # Neutrons/ SUC1 Count | SUC2 | # Neutrons/ SUC2 Count |
|---|---|---|---|---|
| Measured CPS | 35 | | 56 | |
| DIF3D Total Neutrons | 6.68E+2 | 19.1 | 1.28E+3 | 22.9 |

2) Strip Chart Data: Source in Region 22, No Plenum in Upper Reflector CRD Removed from Core

| | SUC1 | # Neutrons/ SUC1 Count | SUC2 | # Neutrons/ SUC2 Count |
|---|---|---|---|---|
| Measured CPS | Unavailable | | 1600 | |
| DIF3D Total Neutrons | 6.82E+2 | Unavailable | 3.39E+4 | 21.2 |

3) Strip Chart Data: Source in Region 22, Plenum Blocks Put Back in Core, CRD Removed from Core

| | SUC1 | # Neutrons/ SUC1 Count | SUC2 | # Neutrons/ SUC2 Count |
|---|---|---|---|---|
| Measured CPS | Unavailable | | 320 | |
| DIF3D Total Neutrons | 6.82E+2 | Unavailable | 2.50E+3 | 7.8 |

4) Strip Chart Data: Source in Region 22, Plenum and CRD Back in Core

| | SUC1 | # Neutrons/ SUC1 Count | SUC2 | # Neutrons/ SUC2 Count |
|---|---|---|---|---|
| Measured CPS | Unavailable | | 90 | |
| DIF3D Total Neutrons | 6.68E+2 | Unavailable | 1.28E+3 | 14.2 |

BASED UPON THE BENCHMARKED MODEL
A SENSITIVITY STUDY WAS PERFORMED TO
ASSESS CORE PERFORMANCE DURING DEFUELING.
THE FOLLOWING PARAMETERS WERE ANALYZED

- NEUTRON SOURCE LOCATION
- NEUTRON SOURCE STRENGTH
- EFFECT OF COCKED CONTROL RODS
- USE OF REPLACEMENT BORONATED REFLECTOR BLOCKS
- REPLACEMENT OF UPPER PLENUM BORONATED BLOCKS
- USE OF PURE GRAPHITE BLOCKS AS SOURCE CONTAINERS
- AGE OF THE CORE IN EFPD

Table V.8

Near End-of-Defueling Performance for
the 232 EFPD FSV Core

Assumptions: (1) 4.0E+9 Sources in Reg 3, Col 3 and Reg 6, Col 6
(2) Rings 3+4 Defueled Minus Regions 10 and 16
(3) 250 EFPD Burnup
(4) Use of Pure Graphite Source Blocks
(5) Replace Boronated Plenum Elements in
Regions 3, 10, 6, and 16

| Core Configuration | SUC 1 #Neutrons | SUC 1 Predicted Count | SUC 2 #Neutrons | SUC 2 Predicted Count |
|---|---|---|---|---|
| All Rods In For Fueled Regions | 2.78E+2 | 13 | 3.17E+2 | 14 |
| All Rods Out for All Regions | 1.52E+3 | 69 | 3.16E+3 | 144 |

# IN CONCLUSION

- THE MODEL AND METHODS PRESENTED ARE TECHNICALLY APPROPRIATE FOR PREDICTING FSV START-UP DETECTOR RESPONSE DURING DEFUELING.
- THE ANALYTICAL METHODS DESCRIBED FORM THE BASIS FOR PREDICTING START-UP DETECTOR COUNT RATE DURING DEFUELING.
- THE METHODS AS DESCRIBED ARE CONSERVATIVE SUCH THAT THE AS-MEASURED COUNT RATE EXPECTED DURING ACTUAL DEFUELING WILL BE EQUAL TO OR GREATER THAN THE PREDICTIONS MADE IN ADVANCE.
- THE MODEL AND METHODS ARE FLEXIBLE ENOUGH TO BE USED FOR OTHER POSSIBLE DEFUELING SCENERIOS SHOULD THE NEED ARISE IN THE FUTURE.

# THE PROBLEM

MAINTAIN ADEQUATE START-UP CHANNEL COUNT RATE DURING FSV DEFUELING UNTIL THERE IS NO LONGER A CREDIBLE MEANS OF ACHIEVING CORE CRITICALITY

# THE SOLUTION

APPLY NEUTRON SOURCE ANALYSIS TO DESIGN IN-CORE CF-252 NEUTRON SOURCES SUCH THAT THE 4.3 COUNTS /SECOND TECHNICAL SPECIFICATION REQUIREMENTS ARE MET THROUGHOUT THE DEFUELING PERIOD.

## ALTERNATIVES FOR DEFUELING
## CASE 0

- IDAHO ISSUES RESOLVED AND DEFUELING TAKES PLACE AS PLANNED

- BEGIN DEFUELING NOV 27, 1989 UTILIZING FUEL STORAGE WELLS (FSW'S) AS A LAG FACILITY CONCURRENT WITH SHIPMENTS TO IDAHO

- PRIMARY ISSUE - UPGRADE OF GSF/READINESS TO RECEIVE FUEL

- FINAL SEGMENT STILL AN ISSUE
  - ACCEPTANCE OF FINAL SEGMENT AT IDAHO
  - BUILD A ONE SEGMENT ISFSI (UTILIZE FSW'S FOR INTERIM STORAGE)
  - USE FSW'S FOR LONG TERM STORAGE

- DEFUELING SEQUENCE/SAR
  - UTILIZE SEQUENCE AS DEFINED IN EXISTING SAR
  - UTILIZE EXISTING SAR BUT WITH A MODIFIED SEQUENCE (UNDER 10CFR50.59)

## ALTERNATIVES FOR DEFUELING
## CASE 1

- BASIC IDAHO ISSUES RESOLVED BUT CANNOT BEGIN SHIPPING TO IDAHO UNTIL MID TO LATE JANUARY 1990

- BEGIN DEFUELING NOV 27, 1989 UTILIZING FSW'S AS A LAG FACILITY

- PRIMARY ISSUE - UPGRADE/READINESS OF GSF TO RECEIVE FUEL ON OR ABOUT JAN 17, 1990

- FINAL SEGMENT STILL AN ISSUE
  - ACCEPTANCE OF FINAL SEGMENT IN IDAHO
  - BUILD A ONE SEGMENT ISFSI (UTILIZE FSW'S FOR INTERIM STORAGE)
  - USE FSW'S FOR LONG TERM STORAGE

- DEFUELING SEQUENCE/SAR
  - UTILIZE SEQUENCE AS DEFINED IN EXISTING SAR
  - UTILIZE EXISTING SAR BUT WITH A MODIFIED SEQUENCE (UNDER 10CFR50.59)

## ALTERNATIVES FOR DEFUELING
## CASE 2

- IDAHO ISSUES CAN BE RESOLVED BUT RESOLUTION IS NOT TIMELY
- DEFUELING
  - BEGIN DEFUELING AS SCHEDULED UTILIZING THE FSW'S AS A LAG FACILITY
  - DELAY DEFUELING UNTIL ISSUES ARE RESOLVED
- FINAL SEGMENT STILL AN ISSUE
  - ACCEPTANCE OF FINAL SEGMENT IN IDAHO
  - BUILD A ONE SEGMENT ISFSI (UTILIZE FSW'S FOR INTERIM STORAGE)
  - UTILIZE FSW'S FOR LONG TERM STORAGE
- DEFUELING SEQUENCE/SAR
  - BEGIN DEFUELING WITH EXISTING SAR WITH MODIFIED SEQUENCE (UNDER 10CFR50.59)
  - UTILIZE THE EXISTING SAR FOR DELAYED DEFUELING
  - PREPARE A NEW SAR TO ACHIEVE LONG TERM, LESS REACTIVE CORE CONDITIONS
  - SOME COMBINATION OF THE ABOVE

## ALTERNATIVES FOR DEFUELING
## CASE 3

- IDAHO ISSUES CANNOT BE RESOLVED

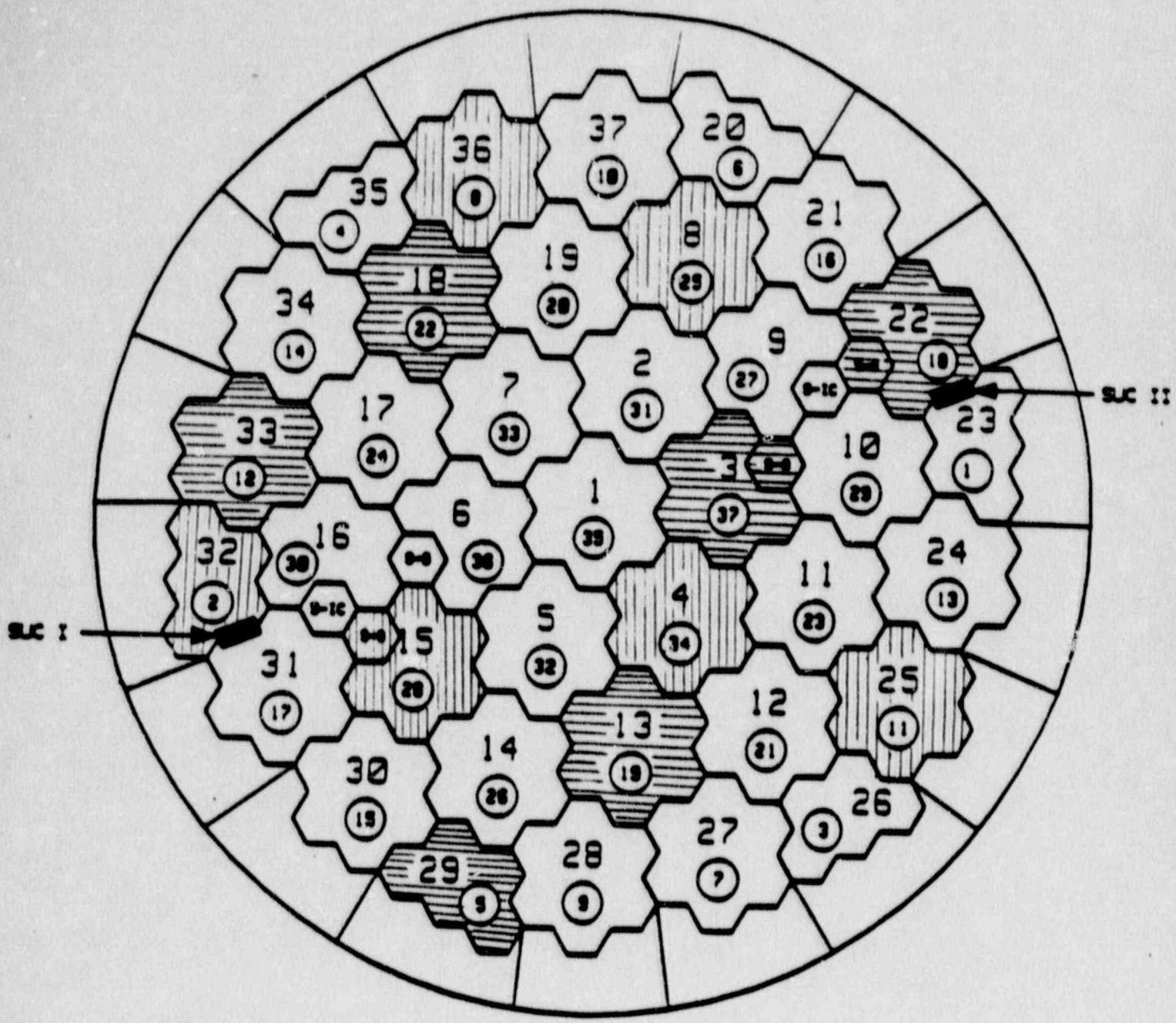
- DEFUELING
  - BEGIN DEFUELING AS SCHEDULED UTILIZING THE FSW'S AS A LAG FACILITY
  - DELAY DEFUELING

- PSC CONSTRUCT A SIX (6) SEGMENT ISFSI

- DEFUELING SEQUENCE/SAR
  - BEGIN DEFUELING WITH EXISTING SAR WITH MODIFIED SEQUENCE (UNDER 10CFR50.59)
  - UTILIZE THE EXISTING SAR FOR DELAYED DEFUELING
  - PREPARE A NEW SAR TO ACHIEVE LONG TERM, LESS REACTIVE REACTOR CORE CONDITIONS
  - SOME COMBINATION OF ABOVE

## REACTOR CORE CONDITIONS FOR VARIOUS ALTERNATIVES

- CASE 0/CASE 1
  - SHRINKING CORE CONCEPT AS DESCRIBED IN SAR
  - CONSIDER RING 4 SEQUENCE CHANGE TO DEFUEL MOST REACTIVE REGIONS FIRST
- CASE 2/CASE 3
  - PRIMARY CONSIDERATION TO PLACE REACTOR IN SAFEST POSSIBLE CONDITION CONSISTENT WITH DELAYS
  - CONSIDER CONTROLLING THE MOST REACTIVE CORE REGIONS (SEGMENTS 8 & 9)
    - DISABLING CONTROL RODS
    - DEFUEL MOST REACTIVE REGIONS
    - UTILIZE RESERVE SHUTDOWN MATERIAL
    - DEFUEL SOME OF THE MOST REACTIVE REGIONS IN COMBINATION WITH RESERVE SHUTDOWN MATERIAL
    - VARIOUS COMBINATIONS OF THE ABOVE




LEGEND

REGION NUMBER 30

SEQUENCE NUMBER (37)

Seg 8

Seg. 9

9-IC SOURCE ELEMENT

IC INITIAL CORE

8,9 SEGMENT 8 OR 9

D DEFUELING

Figure 2-1 Reactor Core Defueling Sequence

## CONSIDERATIONS FOR DELAYED DEFUELING

- SAFETY
  - PRIMARY CONSIDERATION/RESPONSIBILITY IS TO PLACE REACTOR CORE IN THE SAFEST POSSIBLE CONDITION CONSISTENT WITH THE DELAY TIME

- OTHER POSSIBLE BENEFITS
  - ELIMINATE POSSIBILITY OF INADVERTENT REACTIVITY EXCURSIONS
  - REDUCE DECAY HEAT
  - REDUCE SUPPORTING SYSTEMS AND ASSOCIATED SURVEILLANCE AND MAINTENANCE
  - REDUCTION OF VITAL AREAS COULD RESULT IN SECURITY REDUCTION
  - RADIOLOGICAL EMERGENCY RESPONSE PLAN COULD BE DOWNGRADED
  - DEFUELING OPERATIONS AFTER DELAY PERIOD COULD BE SIMPLIFIED
  - POSSIBLE TO SUPPORT POSSESSION ONLY LICENSE
  - BASES FOR EXEMPTIONS TO APPENDIX R AND EQ (10CFR50.49)
  - BASES FOR LIABILITY INSURANCE REDUCTIONS