Integrated Training and Accident Analysis System

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Outline of Presentation

- Project Background
- Overview of RBMK Reactor Design
- Objectives of ITAAS
- Description of ITAAS Features
- Demonstration

Background

- **Accident Analysis and Its Associated Training Programme for the RBMK-1000 Kursk-1 NPP**
- **Extrabudgetary Funds Provided by US and Swiss Governments**
- **In-Kind Contributions From German Government and IAEA NS**
- **“Develop and Establish A Sustainable Accident and Transient Analysis Infrastructure at a Russian Institution”**
- **Develop Capabilities of RBMK Plant Staff**
  - **Perform Independent Accident Analysis Verification/Audit Calculations**
  - **Perform Independent Safety Assessments**

Welcome to the ITAAS
Integrated Training and Accident Analysis System

International Atomic Energy Agency

Idaho National Engineering and Environmental Laboratory, USA

Kursk NPP, Russia

Rosenergoatom, Russia

SEI Ltd., Poland

Russian Research Center "Kurchatov Institute", Russia

Energy Research Inc., USA

GRS, Germany

Sponsored by: US DOS, US DOE, Swiss FNSI and IAEA

Overview of RBMK Reactor Design

- Channel-type Reactor, Boiling Water-Cooled, Graphite-Moderated
  - Graphite Bricks Arranged in a Lattice of Columns, 8 m High
  - Individual Pressure Tubes Contain Water-Cooled Fuel Assemblies (7 m fueled region)
  - Water-steam Mixture Exits to Drum Separator.
  - Steam Drives Turbine, is Condensed, Preheated, Pumped Back to Reactor
- Evolved From Uranium-Graphite Plutonium Production Reactor Design of Former Soviet Union
- Obninsk 1954 – 5MW Electricity-Producing Demonstration
- Seventeen Power Units Have Been Built
  - Leningrad (4 Units)
  - Chernobyl (4 Units)
  - Kursk (4 Units, Unit 5 Under Construction)
  - Smolensk (3 Units)
  - Ignalina (2 Units)

1. РЕАКТОР
2. ТРАКТЫ ТЕХНОЛОГИЧЕСКИХ КАНАЛОВ
3. ПАРОВОДЯНЫЕ КОММУНИКАЦИИ
4. БАРАБАН-СЕПАРАТОР
5. ПАРОВЫЕ КОЛЛЕКТОРЫ
6. ОПУСКНЫЕ ТРУБОПРОВОДЫ
7. ГЛАВНЫЕ ЦИРКУЛЯЦИОННЫЕ НАСОСЫ (ГЦН)
8. РАЗДАТОЧНЫЕ ГРУППОВЫЕ КОЛЛЕКТОРЫ (РГК)
9. ВОДЯНЫЕ КОММУНИКАЦИИ
10. СИСТЕМА КОНТРОЛЯ ГЕРМЕТИЧНОСТИ ОБОЛОЧЕК ТЕПЛОВЫДЕЛЯЮЩИХ ЭЛЕМЕНТОВ (КГО ТВЭЛ)
11. ВЕРХНЯЯ БИОЛОГИЧЕСКАЯ ЗАЩИТА
12. БОКОВАЯ БИОЛОГИЧЕСКАЯ ЗАЩИТА
13. НИЖНЯЯ БИОЛОГИЧЕСКАЯ ЗАЩИТА
14. БАССЕЙН ВЫДЕРЖКИ
15. РАЗГРУЗОЧНО-ЗАГРУЗОЧНАЯ МАШИНА (РЗМ)
16. МОСТОВОЙ КРАН

ОСНОВНЫЕ ХАРАКТЕРИСТИКИ РЕАКТОРА РБМК-1000

ЭЛЕКТРИЧЕСКАЯ МОЩНОСТЬ	1000 МВт
ТЕПЛОВАЯ МОЩНОСТЬ	3140 МВт
РАСХОД ТЕПЛОНОСИТЕЛЯ	$37.5 \cdot 10^3$ Т/Ч
ПАРОПРОИЗВОДИТЕЛЬНОСТЬ	$5.4 \cdot 10^3$ Т/Ч
ТЕМПЕРАТУРА НАСЫЩЕННОГО ПАРА	284 °С
ТЕМПЕРАТУРА ВОДЫ НА ВХОДЕ В РЕАКТОР	270 °С
ДАВЛЕНИЕ В СЕПАРАТОРЕ	70 КГС/СМ^2
НАЧАЛЬНОЕ ОБОГАЩЕНИЕ ТОПЛИВА (UO_2)	1,8 %

РБМК-1000

ГЕТЕРОГЕННЫЙ УРАН-ГРАФИТОВЫЙ РЕАКТОР РБМК-1000 КАНАЛЬНОГО ТИПА ПРЕДНАЗНАЧЕН ДЛЯ ВЫРАБОТКИ НАСЫЩЕННОГО ПАРА С ПОСЛЕДУЮЩЕЙ ПОДАЧЕЙ ЕГО К ТУРБОГЕНЕРАТОРАМ ЭЛЕКТРОСТАНЦИИ. АЭС С РЕАКТОРАМИ РБМК РАБОТАЮТ ПО ОДНОКОНТУРНОЙ СХЕМЕ.

РАБОТУ КОНТУРА ПРИНУДИТЕЛЬНОЙ ЦИРКУЛЯЦИИ ОБЕСПЕЧИВАЮТ ГЛАВНЫЕ ЦИРКУЛЯЦИОННЫЕ НАСОСЫ (ГЦН). РАБОТА РЕАКТОРА ОБЕСПЕЧИВАЕТСЯ РАЗЛИЧНЫМИ СИСТЕМАМИ, СРЕДИ КОТОРЫХ ОСНОВНЫМИ ЯВЛЯЮТСЯ:

СИСТЕМА УПРАВЛЕНИЯ И ЗАЩИТЫ (СУЗ), ОБЕСПЕЧИВАЮЩАЯ УСТОЙЧИВОЕ АВТОМАТИЧЕСКОЕ ПОДДЕРЖАНИЕ МОЩНОСТИ НА ЗАДАННОМ УРОВНЕ;

СИСТЕМА ТЕХНОЛОГИЧЕСКОГО КОНТРОЛЯ, ОБЪЕДИНЯЮЩАЯ СИСТЕМУ ФИЗИЧЕСКОГО КОНТРОЛЯ ЗА РАСПРЕДЕЛЕНИЕМ ЭНЕРГОВЫДЕЛЕНИЯ (СФКРЭ) СИСТЕМУ ПОКАНАЛЬНОГО КОНТРОЛЯ РАСХОДА ВОДЫ ЧЕРЕЗ КАНАЛЫ, СИСТЕМУ КОНТРОЛЯ ГЕРМЕТИЧНОСТИ ТВЭЛОВ (КГО), СИСТЕМУ КОНТРОЛЯ ЦЕЛОСТНОСТИ ТОПЛИВНЫХ КАНАЛОВ (КЦТК), СИСТЕМУ КОНТРОЛЯ ТЕМПЕРАТУРЫ ТЕПЛОНОСИТЕЛЯ И ЭЛЕМЕНТОВ КОНСТРУКЦИЙ РЕАКТОРА.

БИОЛОГИЧЕСКАЯ ЗАЩИТА РЕАКТОРА ОБЕСПЕЧИВАЕТ ДОПУСТИМУЮ САНИТАРНЫМИ НОРМАМИ РАДИАЦИОННУЮ ОБСТАНОВКУ ВО ВСЕХ ПОМЕЩЕНИЯХ.

ВЫГРУЗКА ИЗ ТОПЛИВНЫХ КАНАЛОВ КАССЕТ С ВЫГОРЕВШИМ ТОПЛИВОМ И ТРАНСПОРТИРОВКА К МЕСТУ ХРАНЕНИЯ, А ТАКЖЕ УСТАНОВКА НА ИХ МЕСТЕ СВЕЖИХ, МОЖЕТ ПРОИЗВОДИТЬСЯ НА РАБОТАЮЩЕМ РЕАКТОРЕ.

ПЕРЕГРУЗКА ПРОИЗВОДИТСЯ С ПОМОЩЬЮ СПЕЦИАЛЬНОЙ РАЗГРУЗОЧНО-ЗАГРУЗОЧНОЙ МАШИНЫ (РЗМ).

РЕАКТОРЫ ТИПА РБМК ЯВЛЯЮТСЯ БАЗОЙ ДЛЯ РАЗВИТИЯ БОЛЕЕ МОЩНЫХ РЕАКТОРОВ БЛОЧНОГО ТИПА С ПЕРЕГРЕВОМ ПАРА.

СЭХКО-ОВЦ

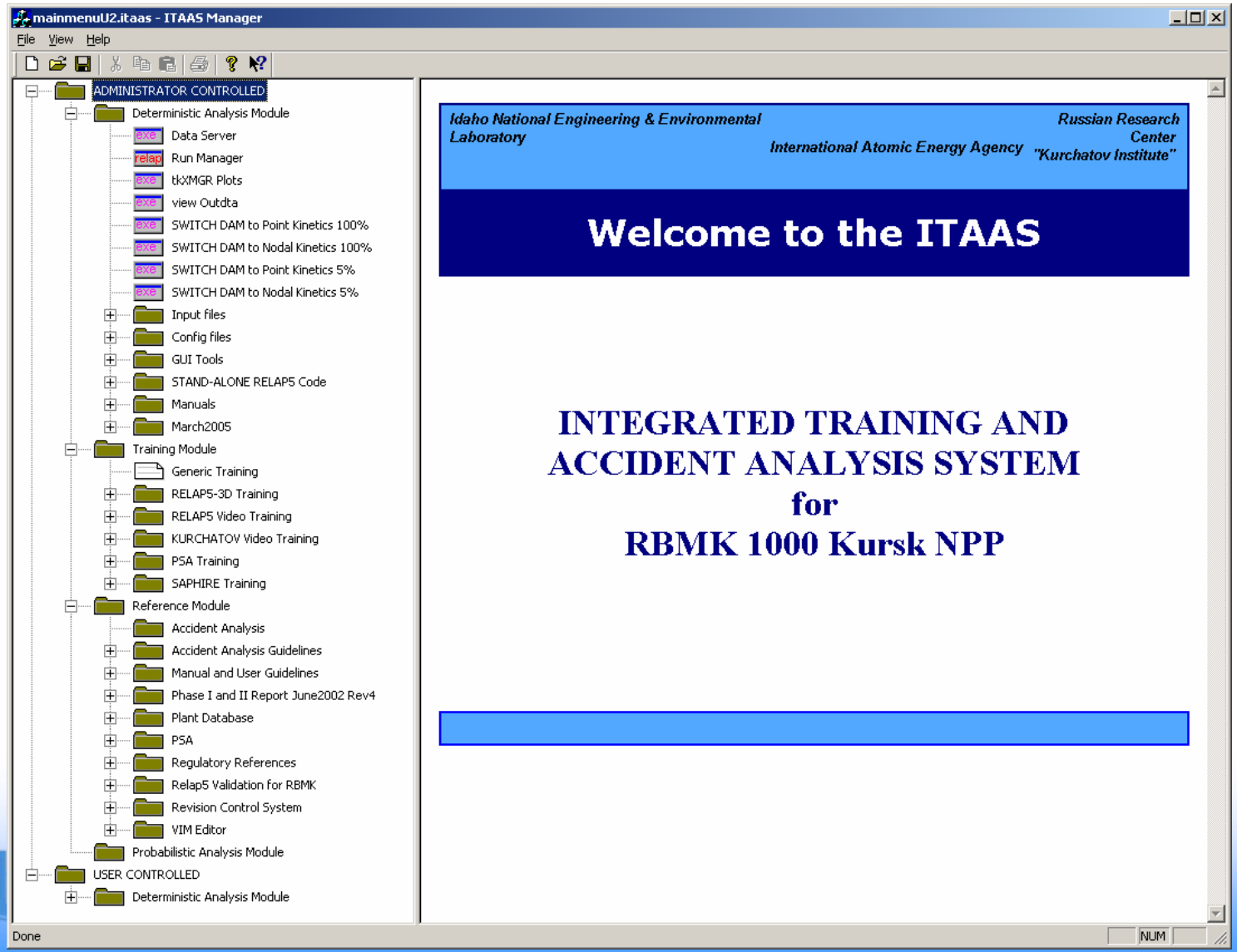
Objectives of ITAAS

- **Comprehensive and Integrated Safety Analysis Capability**
- **Training Materials**
- **Graphical Interface**
- **Reference Materials**
- **Configuration Control Capability**
- **Modular Design and Connectivity**

ITAAS Menu-Driven Screens

- Administrator-Controlled and User-Controlled Parts
  - Deterministic Analysis Module (DAM)
  - Training Module
  - Reference Module
  - Probabilistic Analysis Module (tbs)
- Buttons Execute Scripts, Perform CommonTasks

ITAAS Main Menu



Training Module

- RELAP5-3D Training
  - Presentation Compendium
- RELAP5 Video Training
- Kurchatov Video Training
- PSA Training
- SAPHIRE Training

RELAP5-3D Training

- Self-taught or Instructor Guided – English Only
- Four Modules
  - RELAP5 Basics – Descriptions, Installation, Operation of RELAP5-3D
  - Modeling – Input Model Development, RELAP5 Components, Model Building Exercises
  - Analysis – Guidance for Performing Plant Transient Analysis, Design Basis Accidents, Code Assessment, Quality Assurance
  - Reference – Manuals, Example Input Files, Plant Database and Engineering Handbook

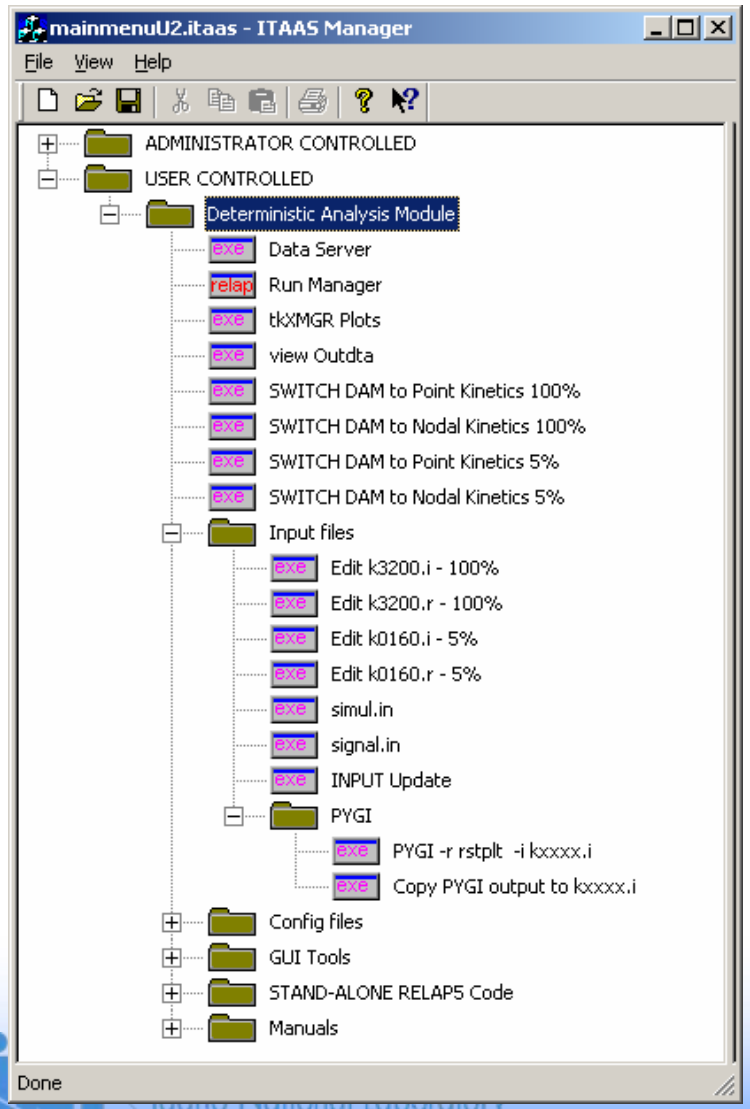
Reference Module

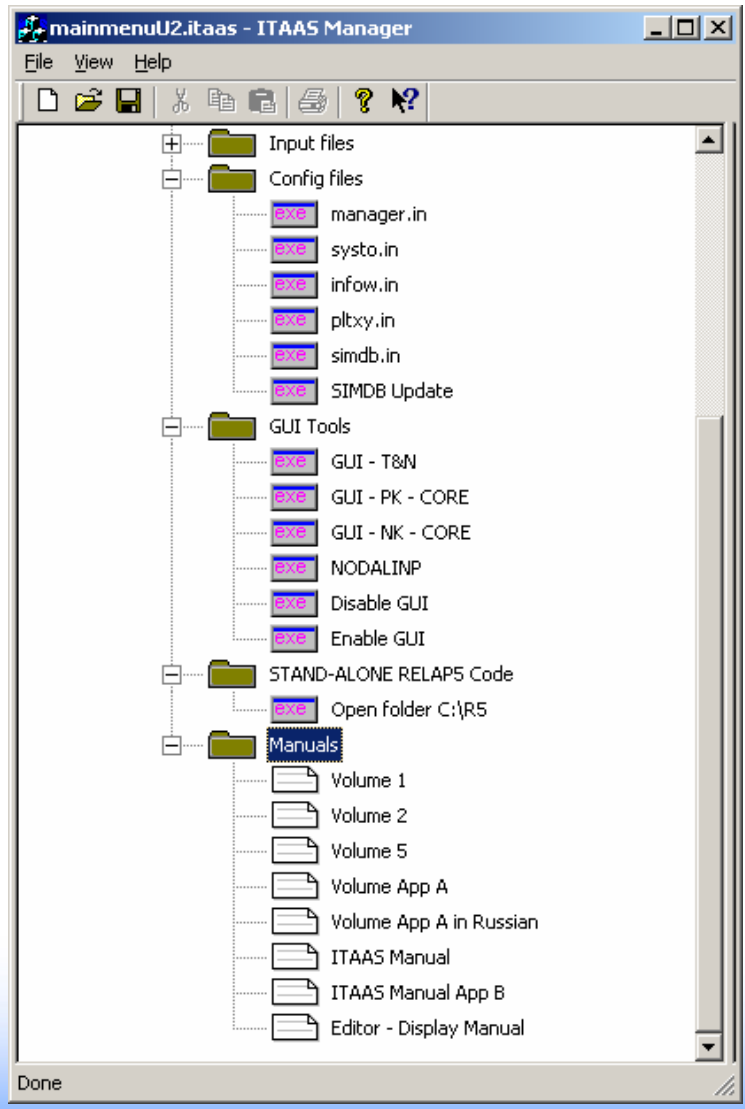
- Accident Analysis Guidelines
  - IAEA Safety Analysis Reports
  - GAN Safety Analysis Guidelines
- Code Manuals
  - RELAP5
  - SAPHIRE
- Phase I and II Reports
- Plant Database
- PSA
- Regulatory References
- RELAP5 Validation Cases
- Revision Control System
- VIM Editor

Deterministic Analysis Module

- Run Manager
- tkXMGR
- Switch Between Nodal Kinetics and Point Kinetics, Switch From High Power To Low Power
- Vim Editor
  - RELAP5 Input Files
  - Malfunctions file
  - Trip Signals File
- Pygi
- Configuration Files
- Gui Tools
- Access Standalone RELAP5
- Manuals

ITAAS Deterministic Analysis Module Main Menu





Run Manager

- Controls Data Transfer Among Various Applications
  - RELAP5
  - Plant Mimics
  - Real Time Plots
- Provides Simulation-User Interface
- Provides Control Window Access To All Simulation Functions And Real Time Plots
- Displays Running Status of RELAP5
- Displays Plant Safety Status and Plant System Status

Run Manager Features

- Simulation Access
  - Start, Stop, Pause, and Restart
  - Malfunction Utility (Interactive Control of Valves, Pumps, Trips)
  - Events Log Viewer
  - Replay
  - Archive
- Real Time Plot Windows
  - Local Plot Variable Frequency Control
  - Can Be Annotated with System Events
  - New Plot Windows Can Be Easily Added

Input Files

- RELAP5-3D Input Files
  - 3200 MW (Full Power)
  - 160 MW (Low Power)
  - Writes to indta.sss
- RELAP5-3D Restart Input Files
  - Writes to indta.res
- Simul.in
  - Malfunction Table
  - Writes to simul.dat
- Signal.in
  - List of RELAP5 Variable Trip Signals
  - Signals Written to Run Manager Events Log
  - Writes to signal.dat

Configuration Files

- Manager.in – Primary Configuration File for Run Manager
  - Network Interface Parameters
  - File Locations
  - Interactive Plot Frequency
- Systo.in, Infow.in, Pltxy.in, Simdb.in
  - Specify Code Parameters For Display
- SIMDB Update

ITAAS - RELAP5 Run Manager - SIMULATION - [manager.pc]

File Commands Manager Plot Malfunctions View Console Help GUI

08.24.05 | RBMK-1000 Kursk NPP - Point Kinetics Model $PK | 12:03:55

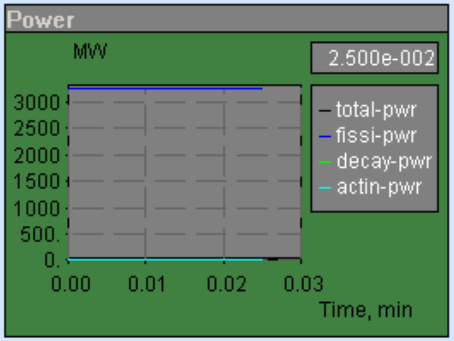
TASK STATUS	TIME [s]	CYCLE	CPU [s]	MODE	LAST RESTART
RUNNING	1.68	981	252.52	1:200.1	436/1.10

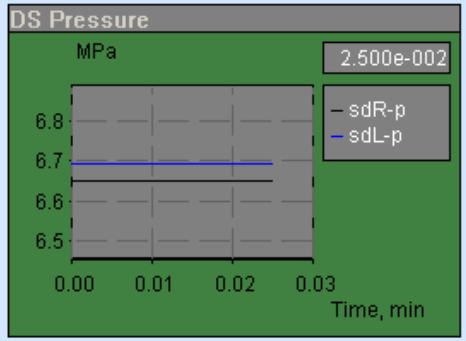
CORE STATUS		
OPERATION		
T(max) = 1438 C	rec.period = 0.0000 1/s	Q = 3200 MW

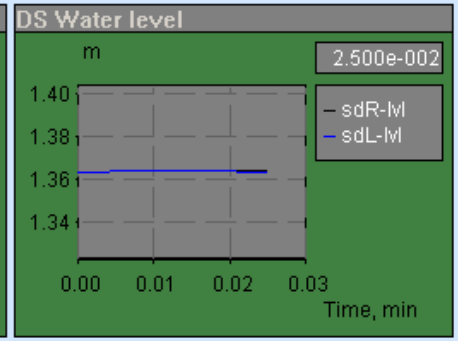
MAIN STEAM SYSTEM STATUS		
TG1 & TG2 OPERATION		
SRV1 f = 750 kg/s	G(MRV+BRU)= 0 kg/s	SRV2 f = 750 kg/s

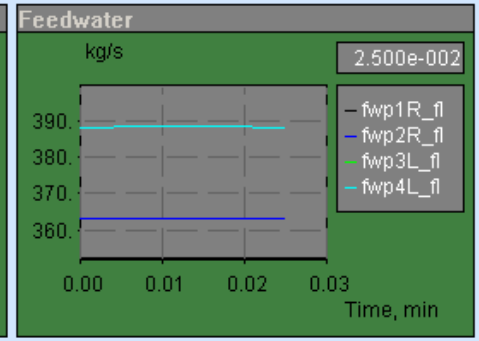
DS1 STATUS		
DS1 LEVEL NORMAL		
LVL = 1.36 m	P = 6.65 MPa	FW f = 725 kg/s

DS2 STATUS		
DS2 LEVEL NORMAL		
LVL = 1.36 m	P = 6.69 MPa	FW f = 775 kg/s









SHUTDOWN	OPTIONS	POWER	MCP	MRVs
AZ BSM	Stdy-St ATWS	AC	1L 2L 3L 1R 2R 3R 4R(i)	11 12 21 22 31 32

FW	CHECK Valves	BRU
4L 3L 2R 1R	1L 2L 3L 1R 2R 3R	K(3v) K(1v) B(1v)

ECCS	DRK (PRV) Valves	Turbine
EFW12 EFW3 EFW45 ACC	1L 2L 3L 1R 2R 3R	SRV1 SRV2

```
 175.0    1.28906     1.562500E-03  2.445647E-04  3.253973E-03       679
 185.2    1.32969     1.562500E-03  2.805507E-04  3.346485E-03       718
 195.5    1.37031     1.562500E-03  5.815990E-04  3.375534E-03       757
 205.5    1.42344     1.562500E-03  1.027434E-03  3.346939E-03       796
cputime  prob.time    time step     err.est       Crnt.limit     adv.cnt.
 215.5    1.48594     1.562500E-03  1.299379E-03  3.404200E-03       836
 225.7    1.54844     1.562500E-03  1.663893E-03  3.359130E-03       876
 236.0    1.59531     1.562500E-03  6.108589E-04  3.431861E-03       916
 246.1    1.64062     1.562500E-03  7.619822E-04  3.403401E-03       955
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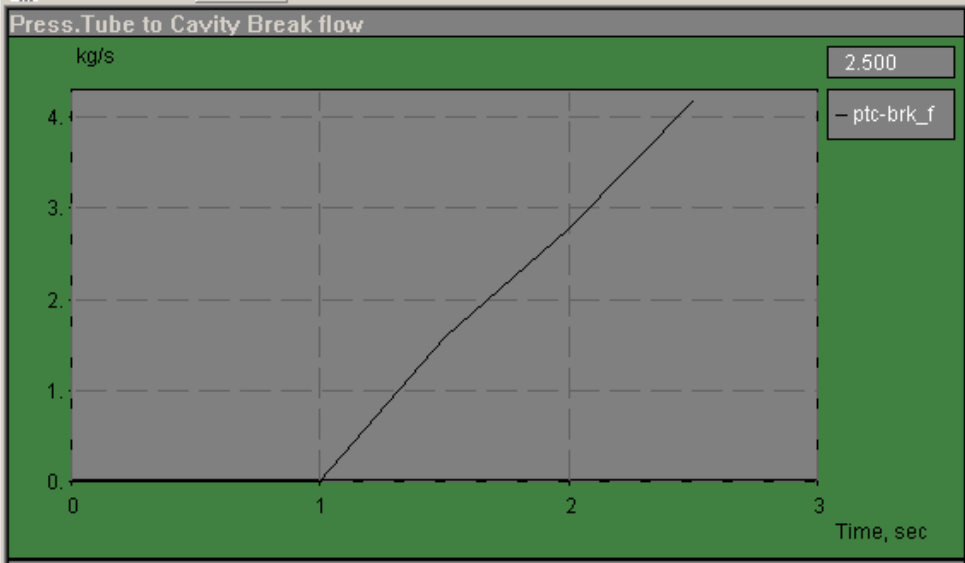
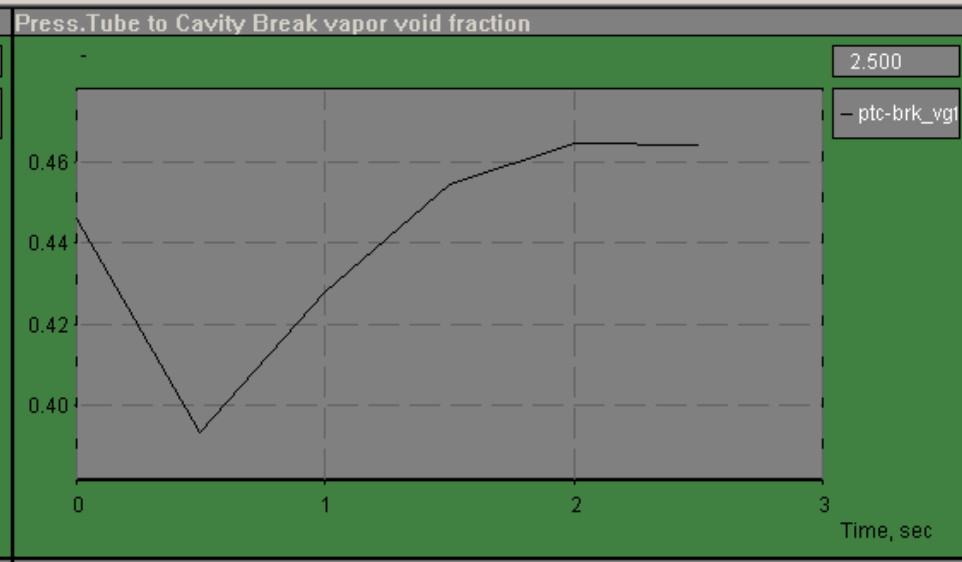
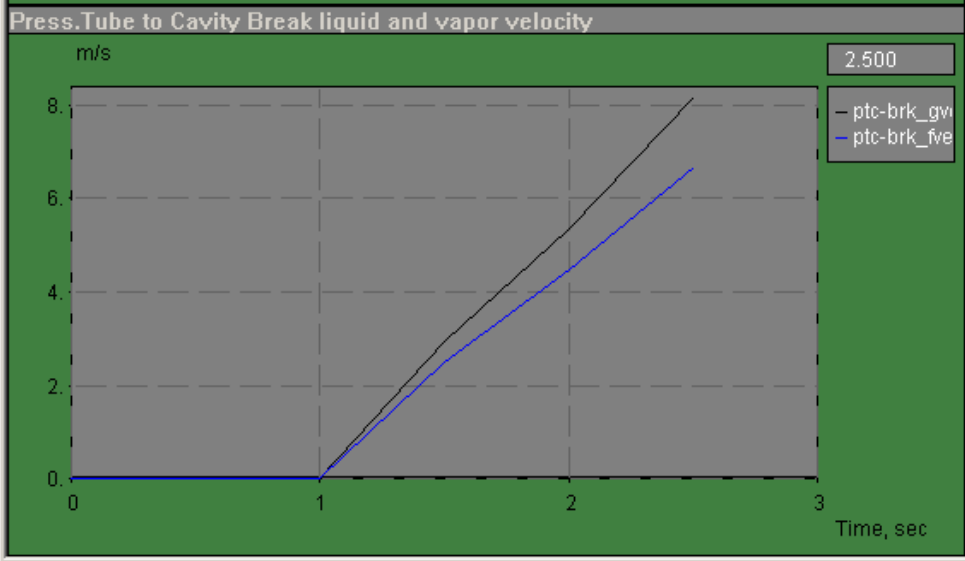
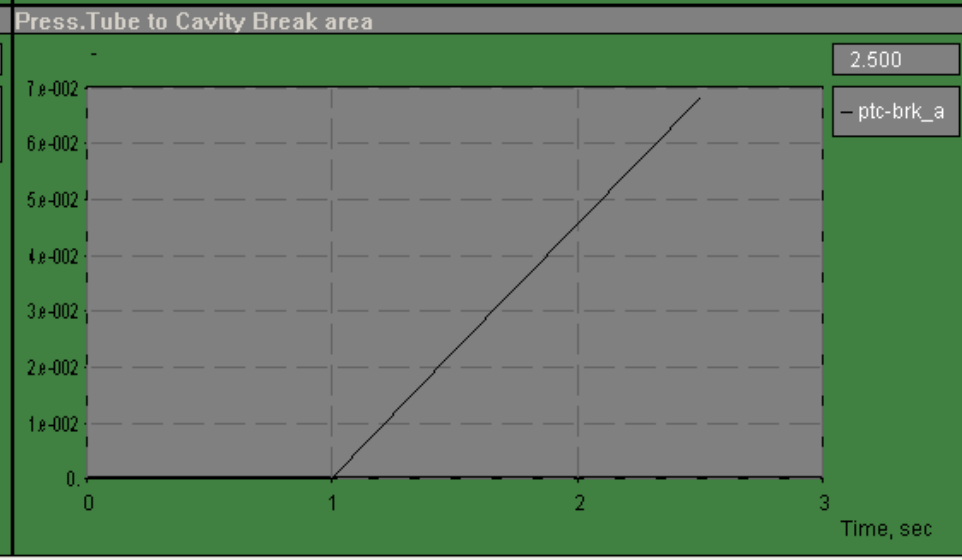
ITAAS - RELAP5 Run Manager - SIMULATION - [brk_pt]

File Commands Manager Plot Malfunctions View Console Help GUI









266.2	1.82187	3.125000E-03	1.062870E-03	3.164493E-03	1035
276.4	1.94687	3.125000E-03	1.637271E-03	3.252676E-03	1075
286.4	2.07812	3.125000E-03	1.056801E-03	3.338740E-03	1117
296.4	2.20312	3.125000E-03	8.783203E-04	3.540502E-03	1157
306.5	2.32812	3.125000E-03	1.083723E-03	3.571657E-03	1197
316.7	2.45937	3.125000E-03	1.321550E-03	3.653656E-03	1239
326.7	2.59062	3.125000E-03	1.403165E-03	3.591314E-03	1281
336.9	2.70937	1.562500E-03	9.841713E-04	3.765850E-03	1322
346.9	2.77500	1.562500E-03	1.590207E-03	4.085016E-03	1364

Technological and Nodalization Screens

- Technological Screens Display System Configuration
- Nodalization Screens Display RELAP5 Nodalization
- All Screens Display Current Values for Parameters of RELAP5 Volumes and Junctions
- Core Screens Display Rod Positions
- Edit Feature Allows Modification

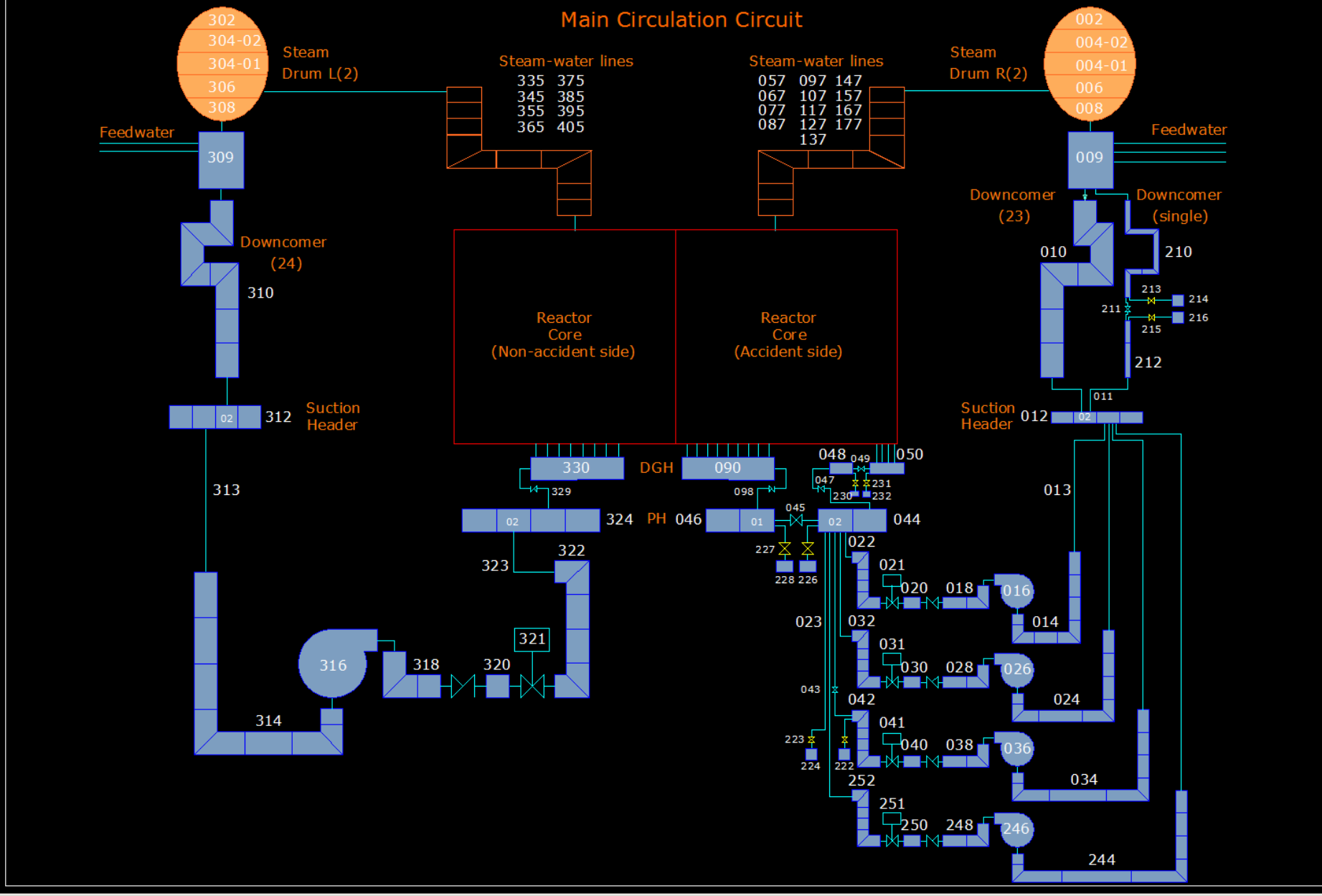
- Displayed on Next 11 Slides

Display - [Rbmk1000_tn.grp]
Technological Nodalization File Editor View Window Help
MCC FEEDWATER STEAM SYSTEM ECCS CPS CORE A-A CORE B-B CORE C-C CORE MAP CONTAINMENT Time: 00:00:10.8
MCC FEEDWATER STEAM SYSTEM ECCS CPS CORE CORE PLAN RX BREAKS LAR AZ SB MCR Time: 10.8
Reactor Cooling Circuit
Система главных паропроводов
F 775.82
P 6.69
T 282.71
H 1.36
Система главных паропроводов
F 723.28
P 6.65
T 282.26
H 1.36
F 387.69
F 387.69
Система подачи питателной боды
F 362.66
F 362.66
F 5241.95
P 6.82
T 269.07
F 5027.94
P 6.78
T 269.73
SH
PH
PH
SH
F 5241.95
F 5246.95
DGH
HEAD RPM P F
HEAD 1.562 RPM 103.150 P 8.36 F 1747.30
HEAD 1.562 RPM 103.150 P 8.36 F 1747.30
HEAD 1.562 RPM 103.150 P 8.36 F 1747.30
P 6.81 F -0.00
HEAD 0.000 RPM 0.000
P 8.31 F 1745.25
HEAD 1.559 RPM 103.150
P 8.31 F 1750.86
HEAD 1.555 RPM 103.150
P 8.31 F 1750.86
HEAD 1.555 RPM 103.150
САОР
СПиР
F 0.00
F 0.00
Система питания ГСП ГЦН

Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

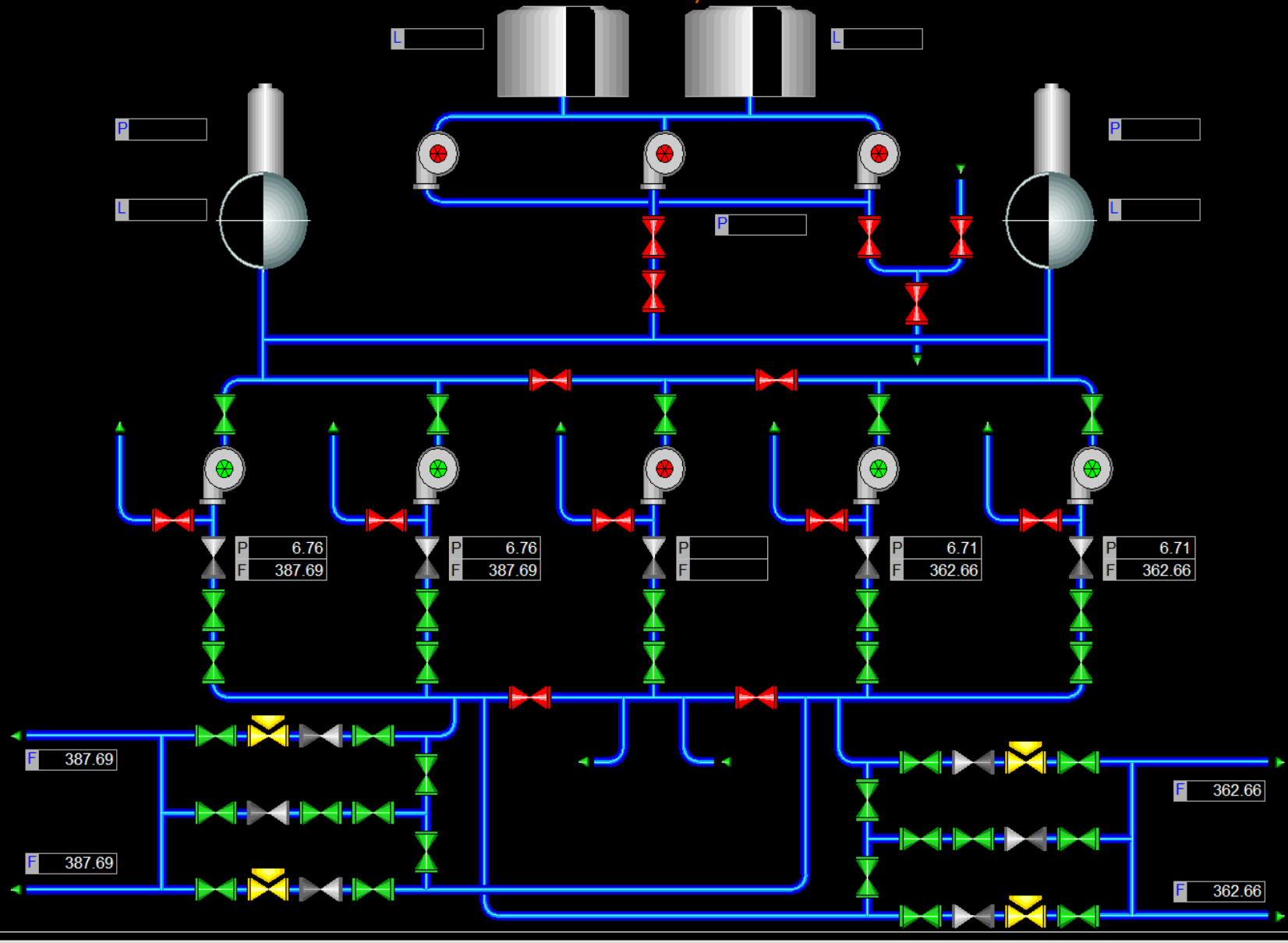


Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Feedwater System

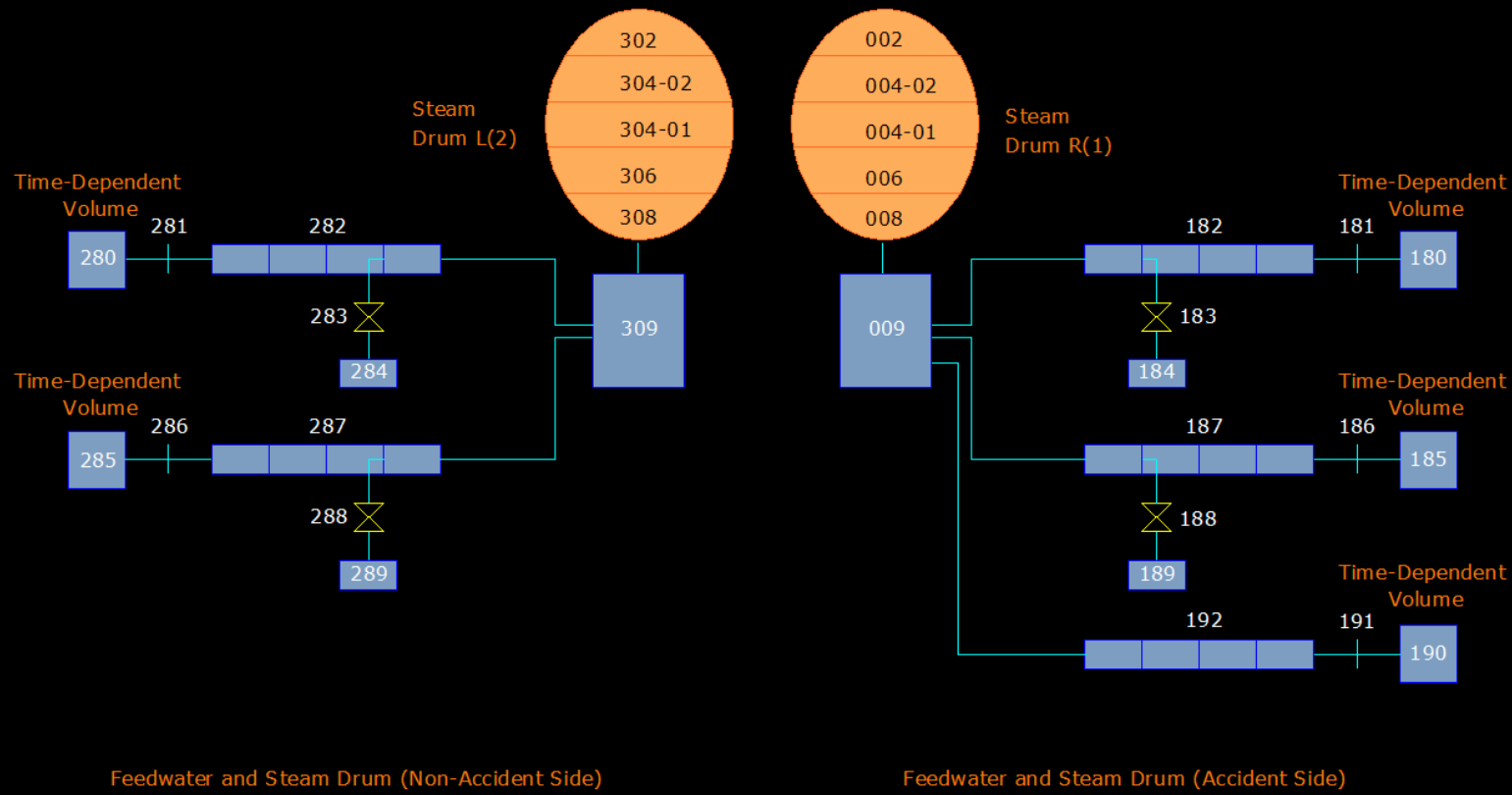


Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Feedwater System



Feedwater and Steam Drum (Non-Accident Side)

Feedwater and Steam Drum (Accident Side)

Steam System

G G G G

B

G G G G

T11113 T11123

T21113 T21123

Кольцо высокого давления

BRU-B

MRV-1 MRV-3 Д01111 MRV-2

Д02111 Д01212 Д01213 Д01214 Д01221 Д01222 Д01223 Д01224

T11234 T11214 T11124 T11244

T11221

T11231 T11241

T11211

T21234 T21214 T21124 T21244

T21221

T21231 T21241

T21211

G 749.60

G 749.60

T11411

T21411

ТГ-1

ТГ-2

T11421

T21421

N

N

Система аварийного приема пара

Система технического водоснабжения

Система циркуляционного бодоснабжения

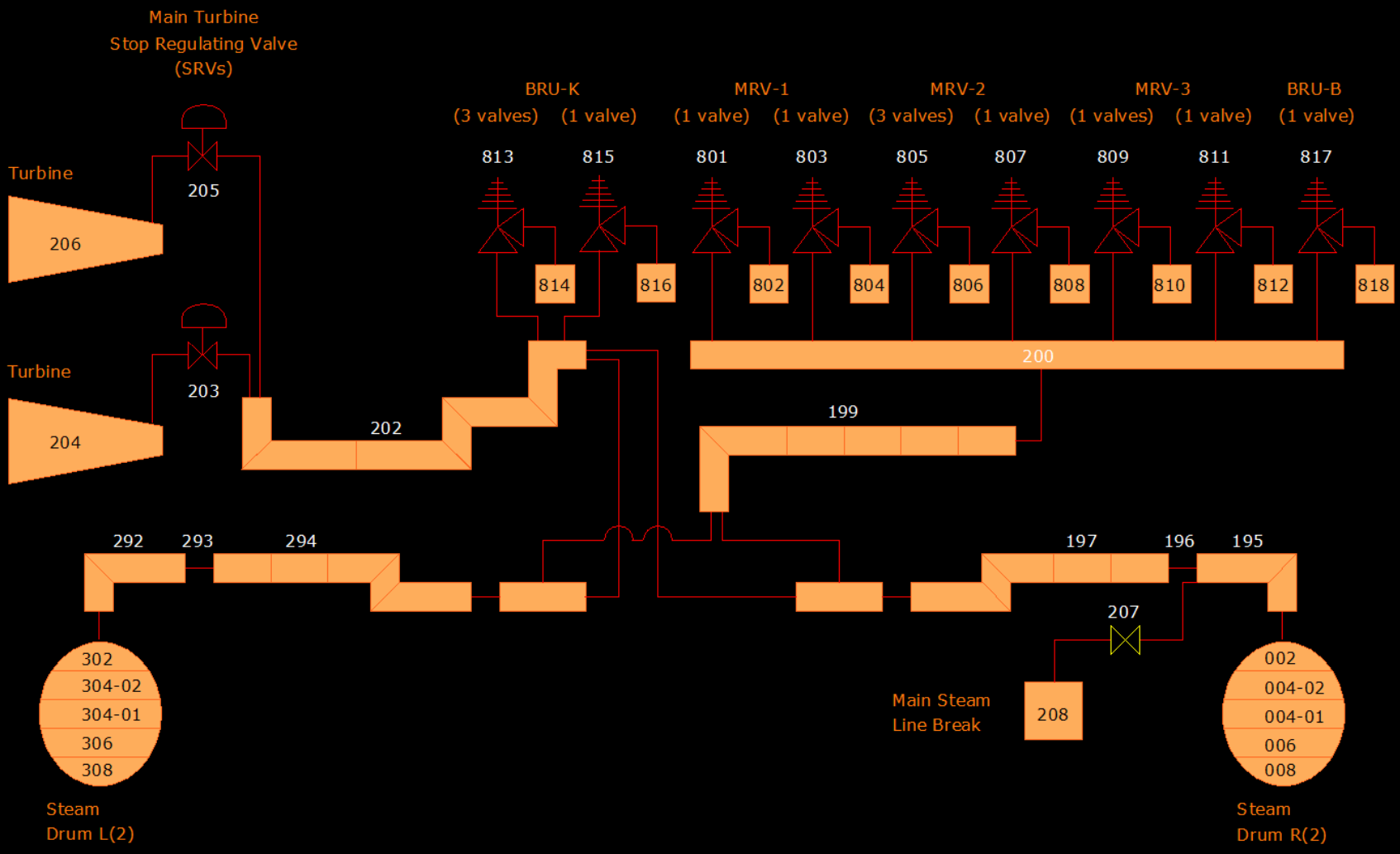
Система циркуляционного бодоснабжения

Display - [Rbmk1000_tn.grp]

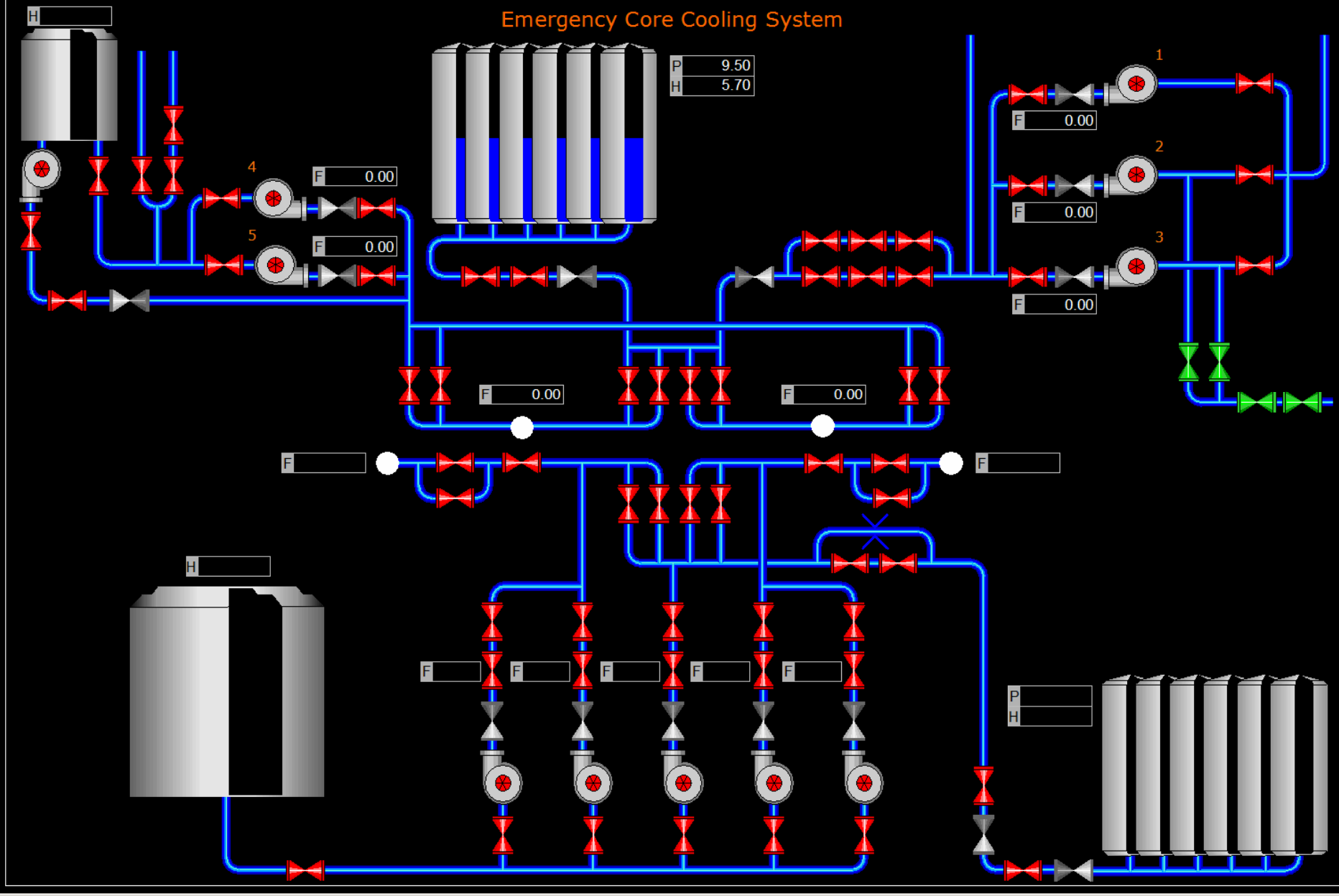
Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

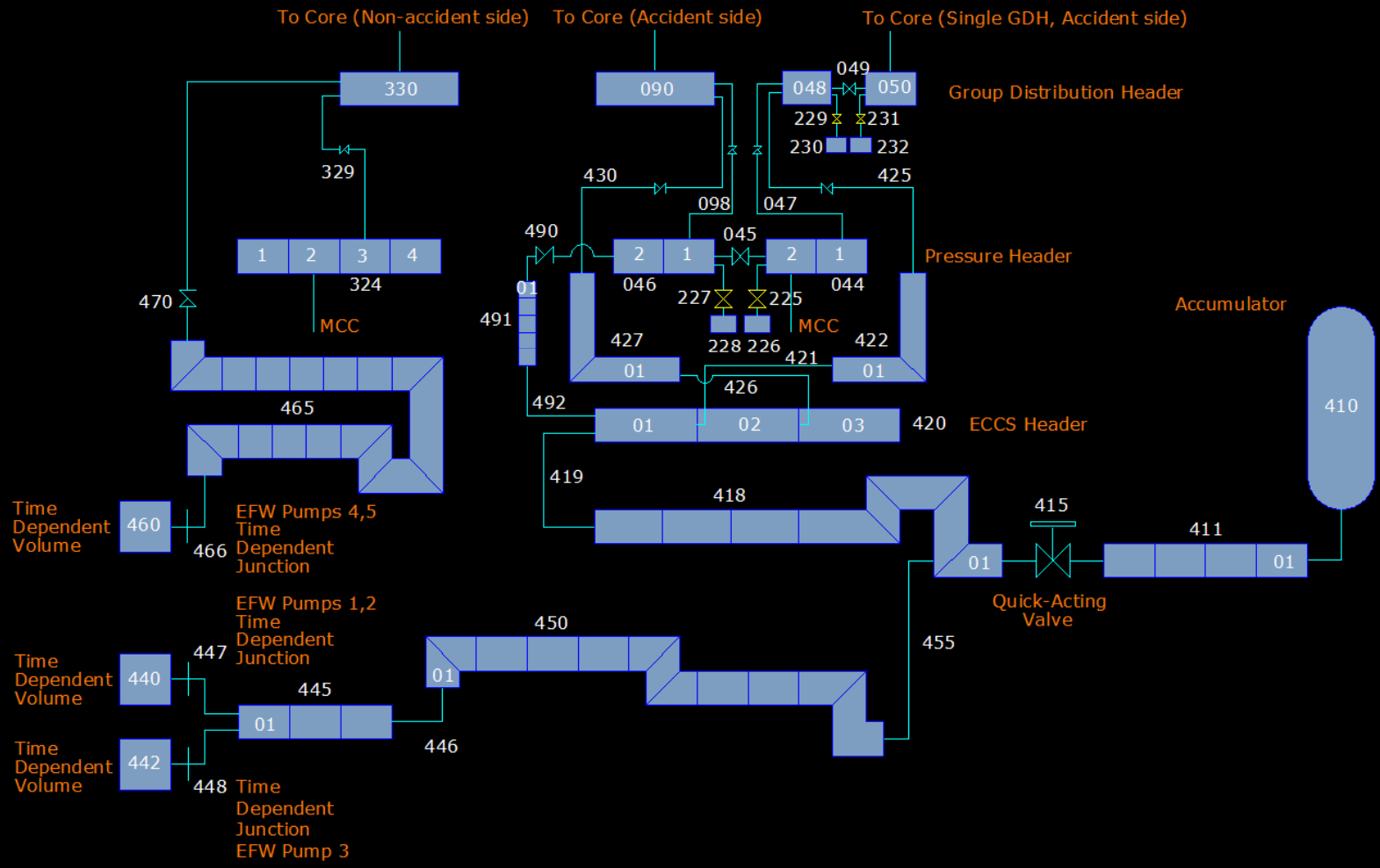
Steam System



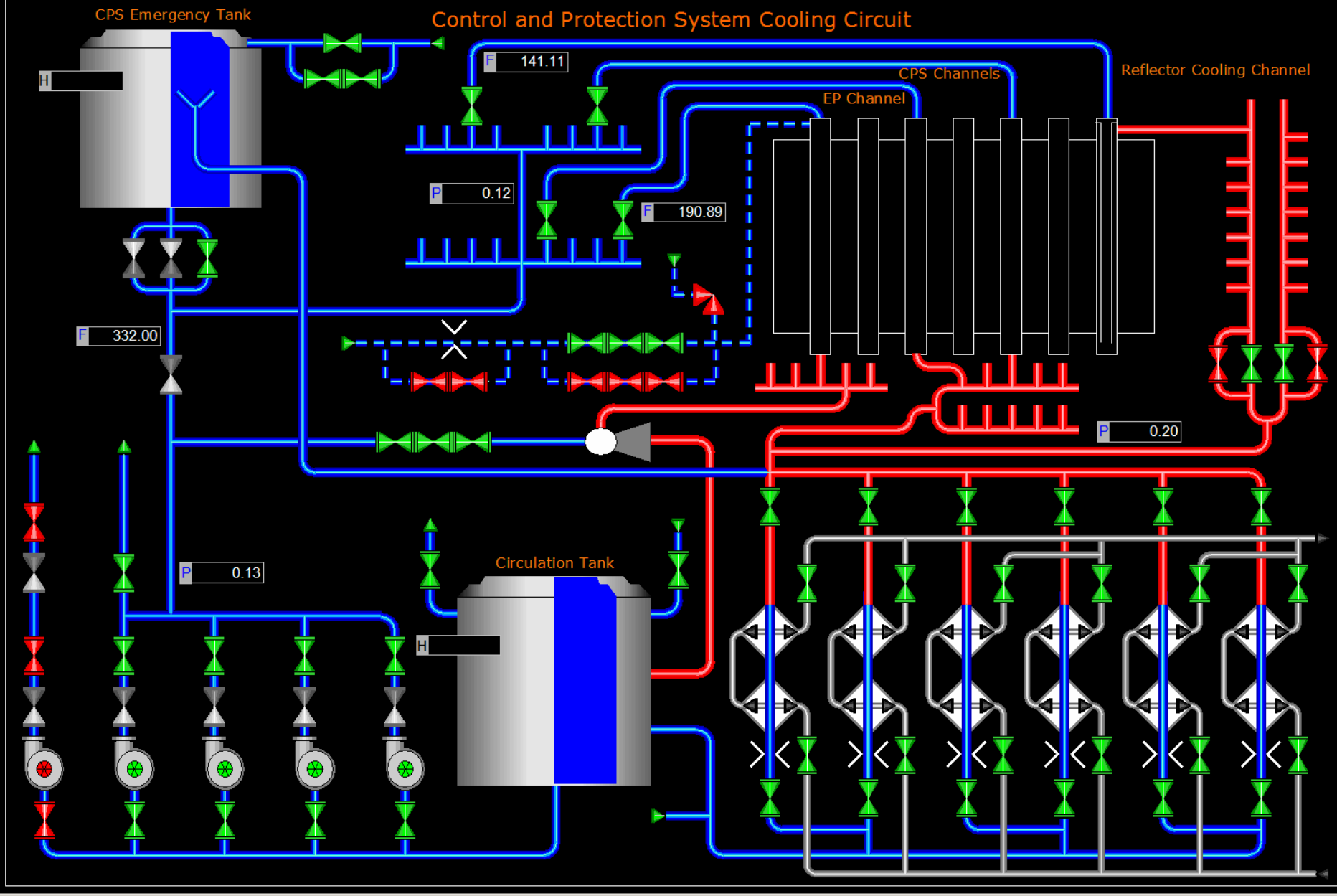
Emergency Core Cooling System



Emergency Core Cooling System



Control and Protection System Cooling Circuit

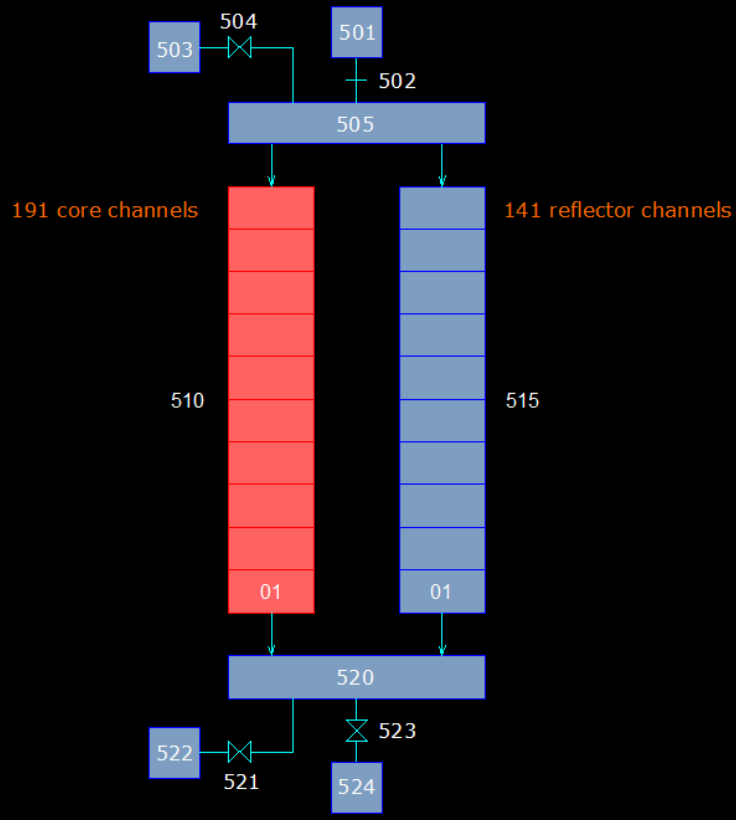


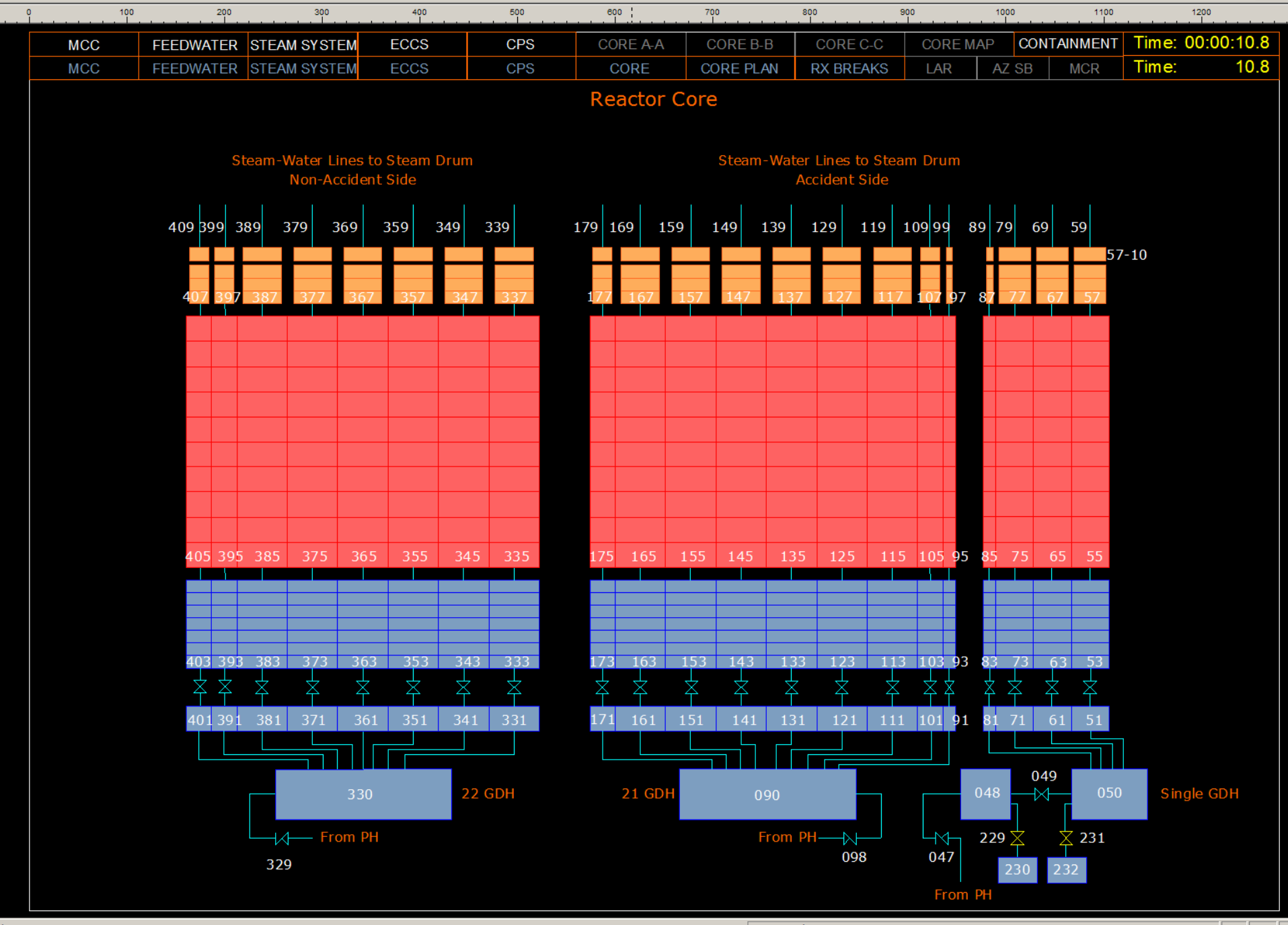
Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Core Protection System Cooling System



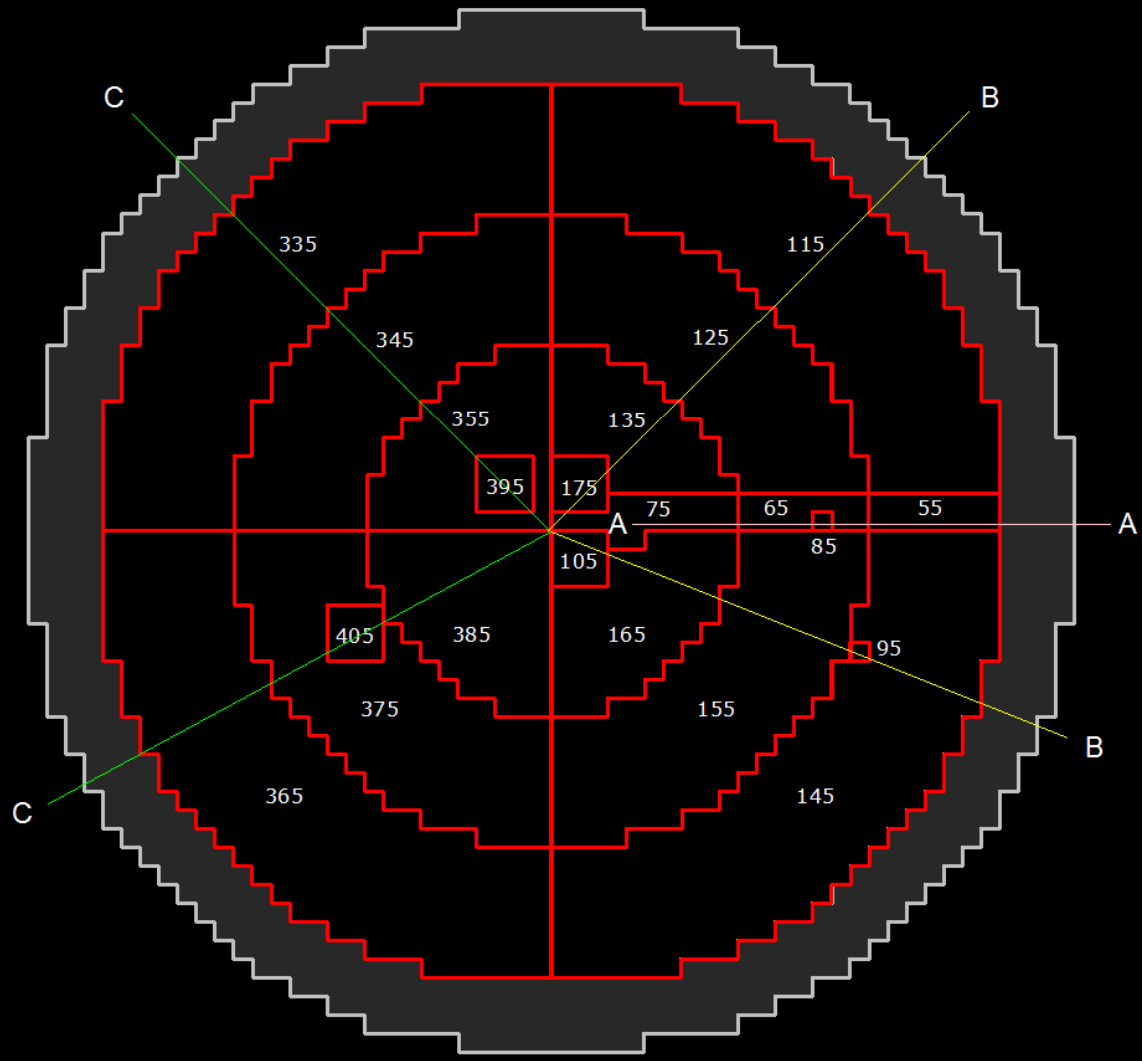

MCC
FEEDWATER
STEAM SYSTEM
ECCS
CPS
CORE A-A
CORE B-B
CORE C-C
CORE MAP
CONTAINMENT
Time: 00:00:10.8
MCC
FEEDWATER
STEAM SYSTEM
ECCS
CPS
CORE
CORE PLAN
RX BREAKS
LAR
AZ SB
MCR
Time: 10.8
Reactor Core
Steam-Water Lines to Steam Drum
Non-Accident Side
Steam-Water Lines to Steam Drum
Accident Side
409 399 389 379 369 359 349 339
179 169 159 149 139 129 119 109 99 89 79 69 59
57-10
407 397 387 377 367 357 347 337
177 167 157 147 137 127 117 107 97 87 77 67 57
405 395 385 375 365 355 345 335
175 165 155 145 135 125 115 105 95 85 75 65 55
403 393 383 373 363 353 343 333
173 163 153 143 133 123 113 103 93 83 73 63 53
401 391 381 371 361 351 341 331
171 161 151 141 131 121 111 101 91 81 71 61 51
330
22 GDH
From PH
329
21 GDH
090
From PH
098
048
049
050
Single GDH
047
229
231
230
232
From PH

Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Plan View of the Core

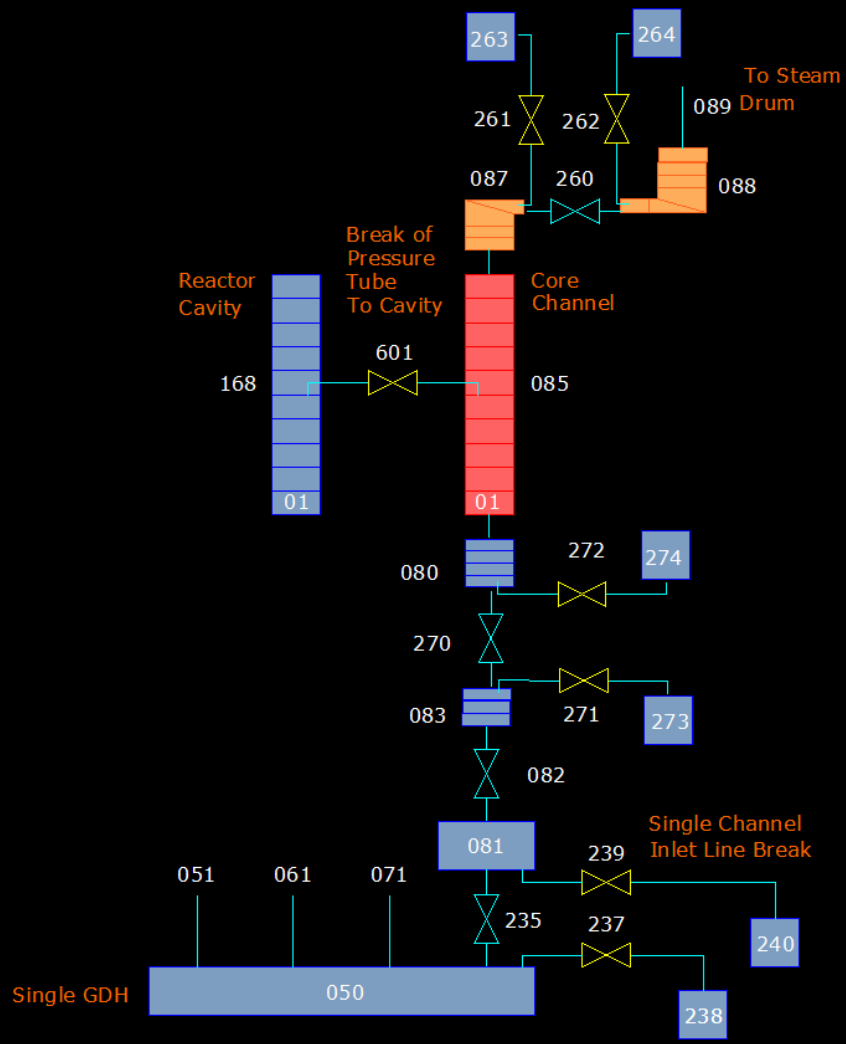


Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Break Models



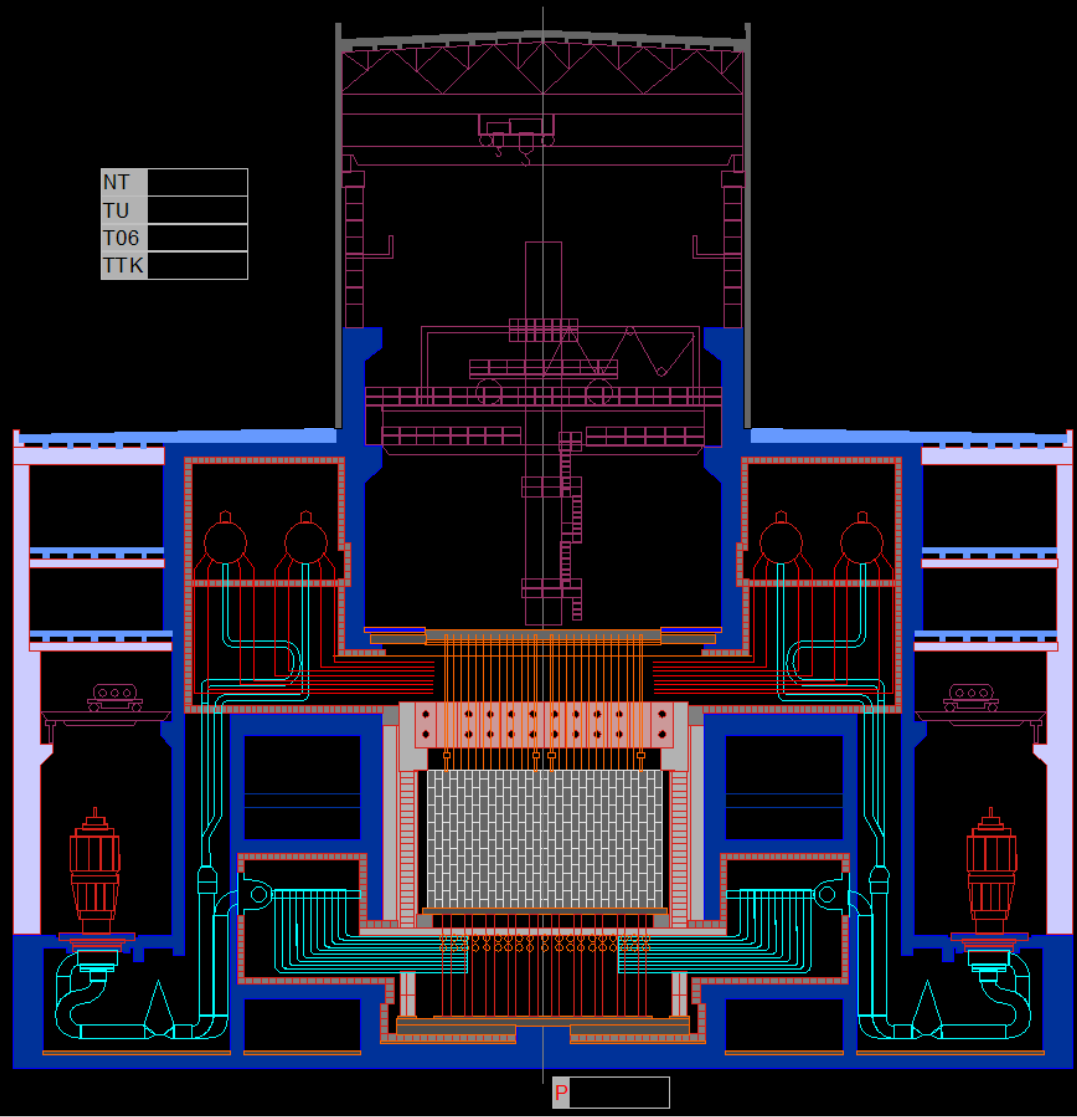
Display - [Rbmk1000_tn.grp]

Technological Nodalization File Editor View Window Help

0 100 200 300 400 500 600 700 800 900 1000 1100 1200

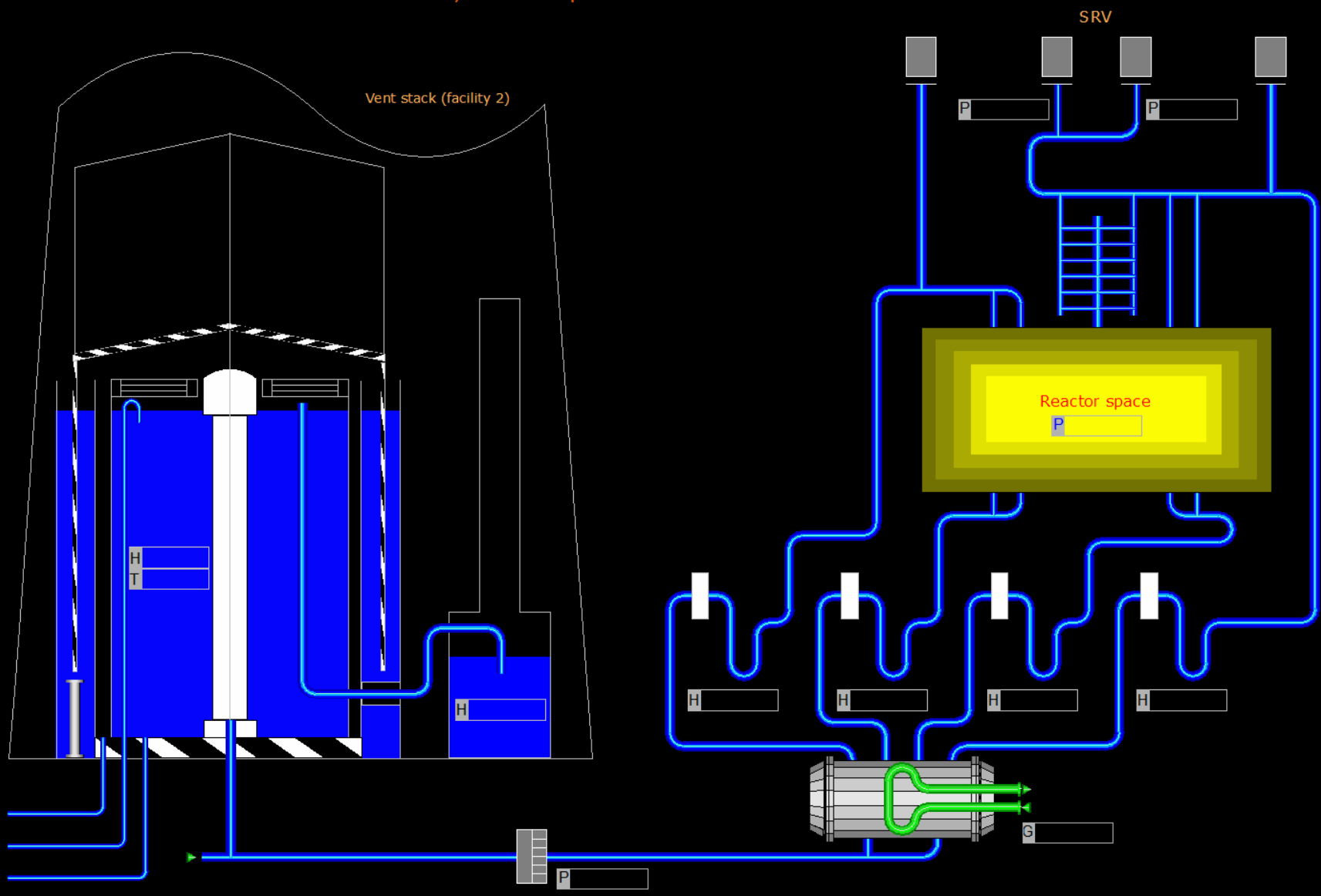
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Containment



Reactor Cavity Venting System

the system is not presented in RELAP5-3D calculations



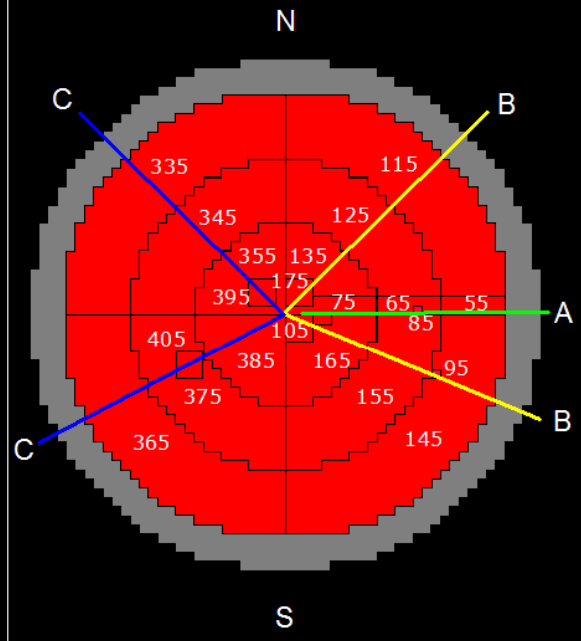
Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Core

Horizontal Cross Section

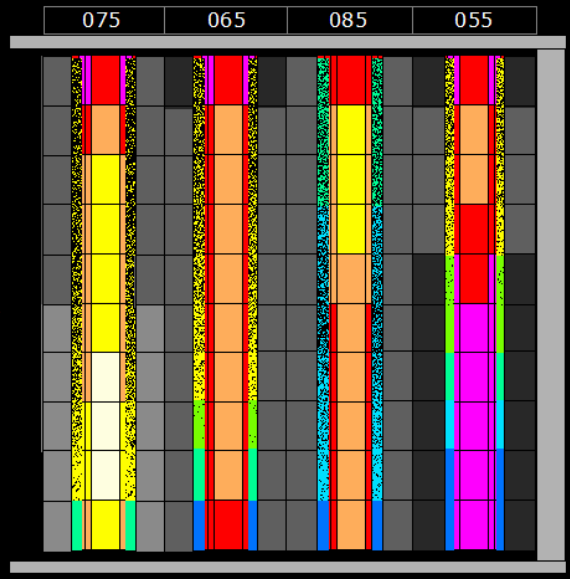


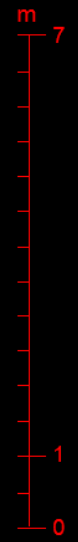
Cross Section A-A

Fuel Max.Temperature and Cladding Surface Temperature

Graphite Average Temperature

Channel Liquid Void Fraction and Liquid Temperature





Axial Segment No 1

Assemblies Group No 1

Fuel max. temperature	[°C]	1164.4
Cladding temperature	[°C]	292.6
Average temperature	[°C]	910.9
Heat Flux	[kW/m^2]	504.5
Critical Heat Flux	[kW/m^2]	3815.2
Void Fraction	[%]	100.0

Reactor Power

fission	2961.10 MW t
decay	238.92 MW t
act. decay	14.28 MW t
total	3200.02 MW t

Graphite Temp. °C

- < 400
- 400 - 500
- 500 - 600
- 600 - 700
- 700 <

Fuel Temperature °C

- < 200
- 200 - 300
- 300 - 400
- 400 - 600
- 600 - 800
- 800 - 1000
- 1000 - 1200
- 1200 <

Water Temperture °C

- < 268
- 268 - 272
- 272 - 276
- 276 - 280
- 280 - 284
- 284 - 288
- 288 - 292
- 292 - 296
- 296 - 300
- 300 <

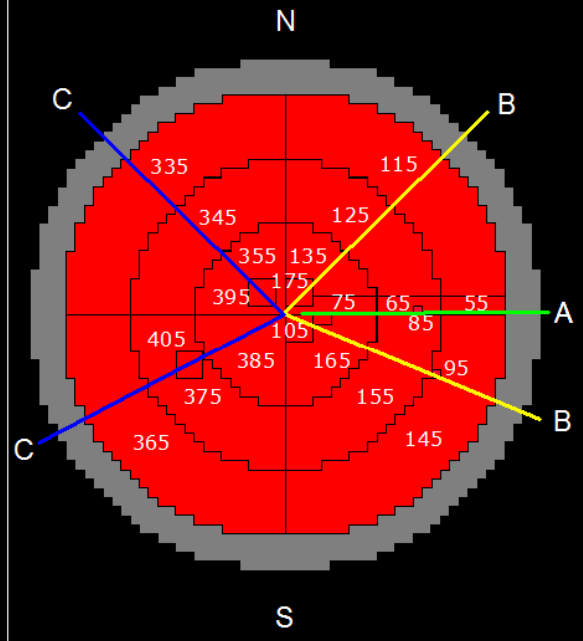
Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

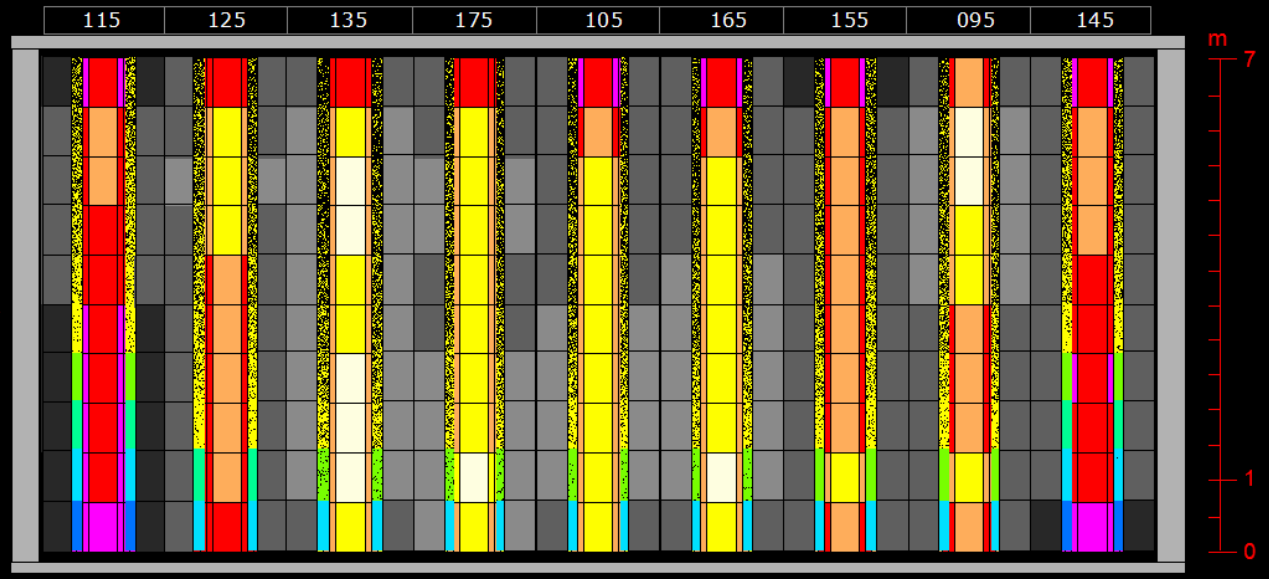
Core

Horizontal Cross Section



Cross Section B-B

Fuel Max.Temperature and Cladding Surface Temperature | Graphite Average Temperature | Channel Liquid Void Fraction and Liquid Temperature



Graphite Temp. °C

< 400
400 - 500
500 - 600
600 - 700
700 <

Fuel Temperature °C

< 200
200 - 300
300 - 400
400 - 600
600 - 800
800 - 1000
1000 - 1200
1200 <

Water Temperture °C

< 268
268 - 272
272 - 276
276 - 280
280 - 284
284 - 288
288 - 292
292 - 296
296 - 300
300 <

Axial Segment No 1

Channels Group No 1

Fuel max. temperature	[°C]	589.8
Cladding temperature	[°C]	276.6
Average temperature	[°C]	518.4
Heat Flux	[kW/m^2]	201.1
Critical Heat Flux	[kW/m^2]	0.0
Void Fraction	[%]	100.0

Reactor Power

fission	2961.10 MW t
decay	238.92 MW t
act. decay	14.28 MW t
total	3200.02 MW t

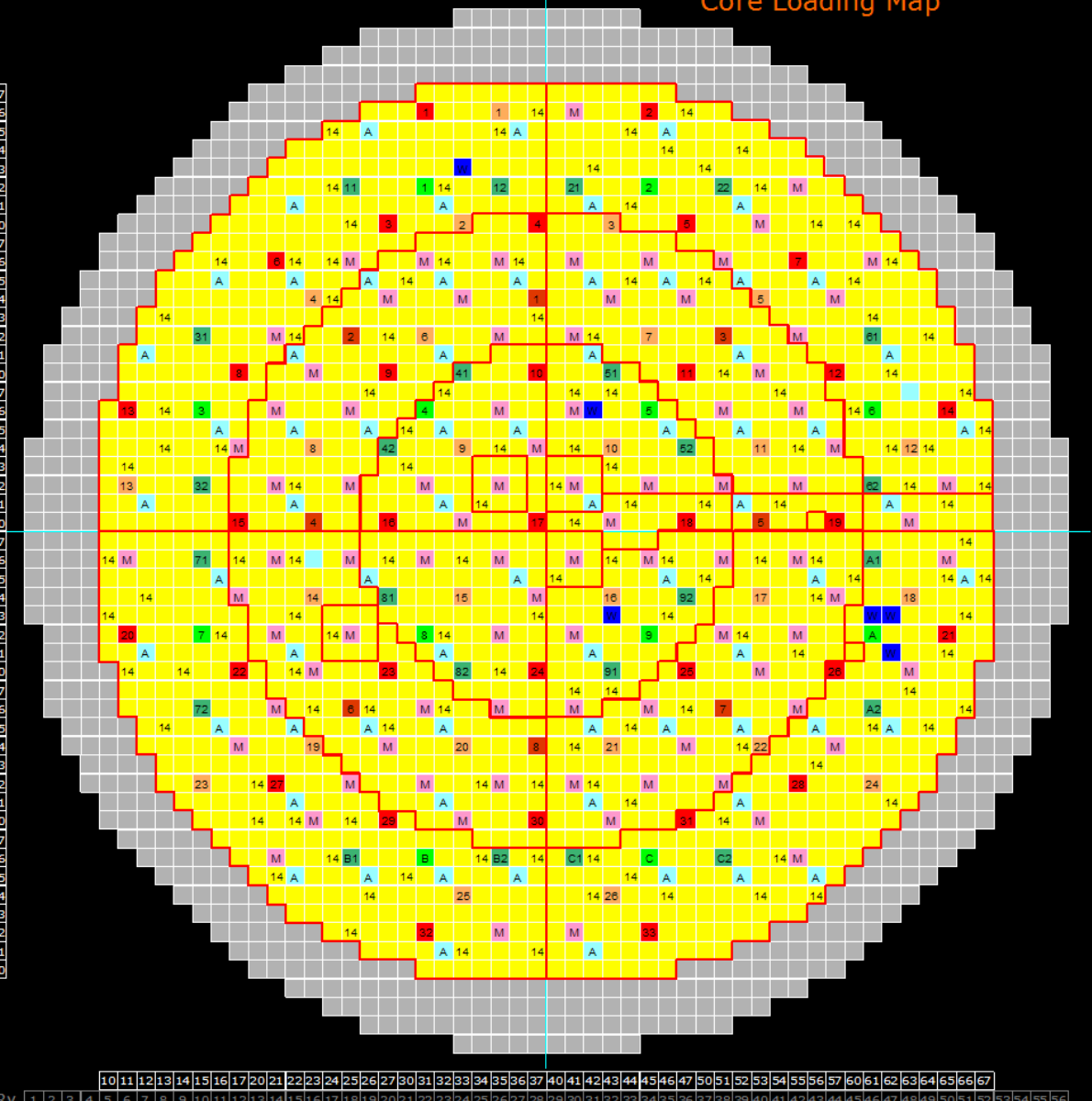
Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

MCC | FEEDWATER | STEAM SYSTEM | ECCS | CPS | CORE A-A | CORE B-B | CORE C-C | CORE MAP | CONTAINMENT | Time: 00:00:10.8

MCC | FEEDWATER | STEAM SYSTEM | ECCS | CPS | CORE | CORE PLAN | RX BREAKS | LAR | AZ SB | MCR | Time: 10.8

Core Loading Map



No	Symbol	Description
604		Graphite
1475		Fuel assembly 2.4%
140	14	Fuel assembly 2.8% + 0.6%Er
AZ 33		FASS rods
SB 26		Short Bottom control rods
C 8		Control rods 2091 type
LAR 12		
LARC 24		Control rods 2477 type
R 88	M	
6	W	CPS water column
70	A	Additional absorber
2		Empty channel

Shutdown Signal

AZ

BSM

Coordinates	Symbol	Description
Rx		RELAP5 coordinate x
Ry		RELAP5 coordinate y
Kx		Plant coordinate x
Ky		Plant coordinate y

Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

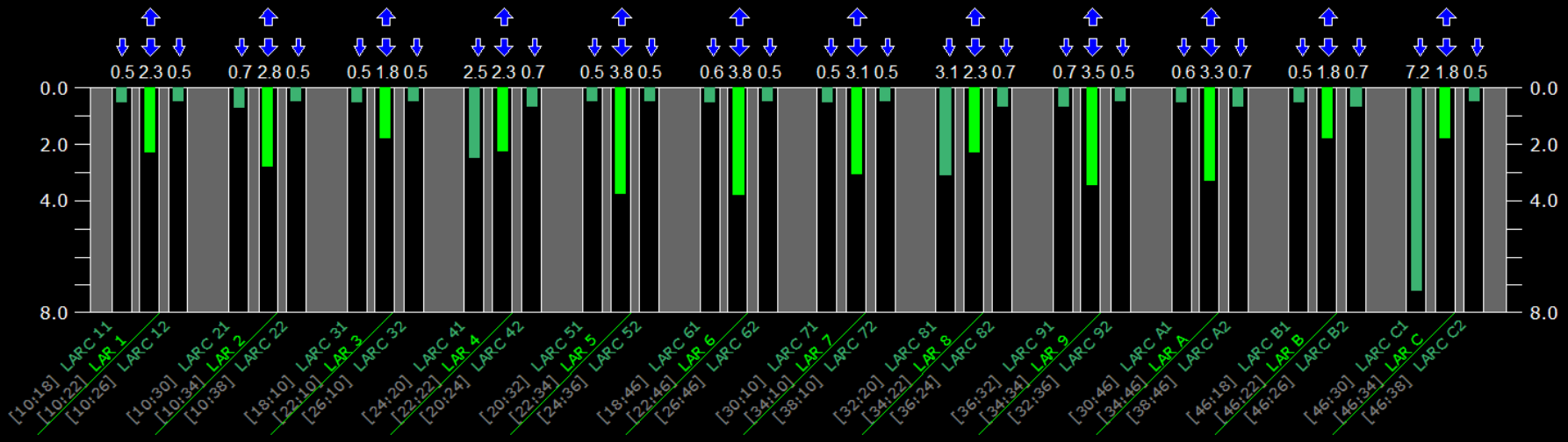
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Power Adjusting Control Rods (LAR & LARC)

Shutdown Signal

AZ

BSM



Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE A-A	CORE B-B	CORE C-C	CORE MAP	CONTAINMENT	Time: 00:00:10.8
MCC	FEEDWATER	STEAM SYSTEM	ECCS	CPS	CORE	CORE PLAN	RX BREAKS	LAR	AZ SB	MCR	Time: 10.8

Fast Acting and Short Bottom Control Rods

Shutdown Signal

AZ

BSM

Fast Acting control rods

0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5

0.0 2.0 4.0 8.0

[6:22] AZ 01 [6:34] AZ 02 [12:20] AZ 03 [12:28] AZ 04 [12:36] AZ 05 [14:14] AZ 06 [14:42] AZ 07 [20:12] AZ 08 [20:20] AZ 09 [20:28] AZ 10 [20:36] AZ 11 [20:44] AZ 12 [22:6] AZ 13 [22:50] AZ 14 [28:12] AZ 15 [28:20] AZ 16 [28:28] AZ 17 [28:36] AZ 18 [28:44] AZ 19 [34:6] AZ 20 [34:50] AZ 21 [36:12] AZ 22 [36:20] AZ 23 [36:28] AZ 24 [36:36] AZ 25 [36:44] AZ 26 [42:14] AZ 27 [42:42] AZ 28 [44:20] AZ 29 [44:28] AZ 30 [44:36] AZ 31 [50:22] AZ 32 [50:34] AZ 33

Short Bottom control rods

1.0 1.0 1.0 1.0 1.0 4.5 4.2 1.8 2.2 4.5 4.0 1.0 1.0 3.5 2.5 3.5 4.5 1.0 2.4 4.5 2.8 1.6 1.0 1.0 1.0 2.6

0.0 2.0 4.0 8.0

[6:26] SB 01 [12:24] SB 02 [12:32] SB 03 [16:16] SB 04 [16:40] SB 05 [18:22] SB 06 [18:34] SB 07 [24:16] SB 08 [24:24] SB 09 [24:32] SB 10 [24:40] SB 11 [24:48] SB 12 [26:6] SB 13 [32:16] SB 14 [32:24] SB 15 [32:32] SB 16 [32:40] SB 17 [32:48] SB 18 [40:16] SB 19 [40:24] SB 20 [40:32] SB 21 [40:40] SB 22 [42:10] SB 23 [42:46] SB 24 [48:24] SB 25 [48:32] SB 26

Manual Control rods 2091 type

0.5 0.5 2.8 0.5 1.8 0.5 0.5 0.5

0.0 2.0 4.0 8.0

[16:28] C 01 [18:18] C 02 [18:38] C 03 [28:16] C 04 [28:40] C 05 [38:18] C 06 [38:38] C 07 [40:28] C 08

Display - [Rbmk1000nk_core.grp]

Screens File Editor View Window Help

MCC | FEEDWATER | STEAM SYSTEM | ECCS | CPS | CORE A-A | CORE B-B | CORE C-C | CORE MAP | CONTAINMENT | Time: 00:00:10.8

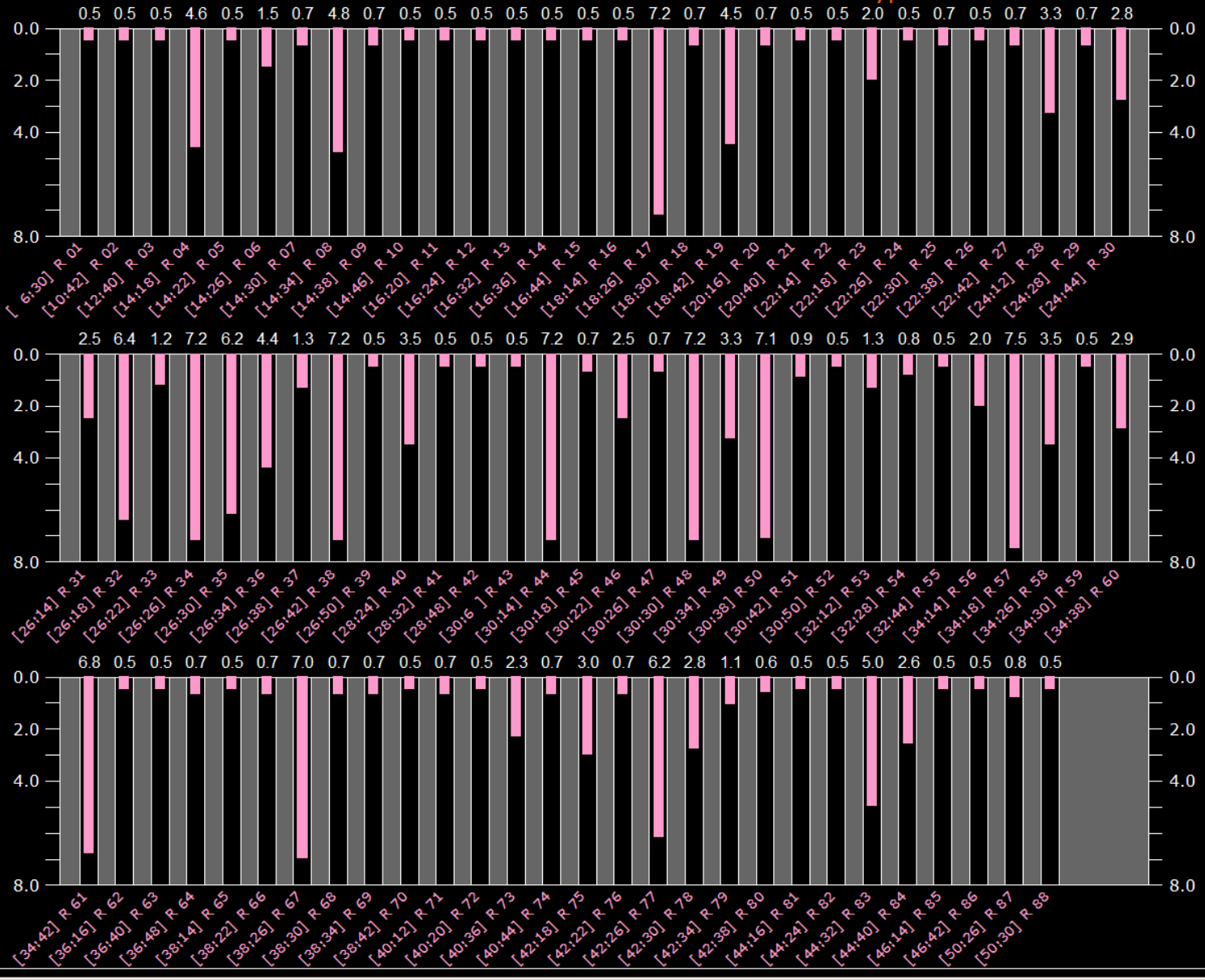
MCC | FEEDWATER | STEAM SYSTEM | ECCS | CPS | CORE | CORE PLAN | RX BREAKS | LAR | AZ SB | MCR | Time: 10.8

Manual Control Rods 2477 Type

Shutdown Signal

AZ

BSM



Manual Control rods 2477 type

Manual Control rods 2477 type

Manual Control rods 2477 type