



# United States Department of the Interior

GEOLOGICAL SURVEY  
BOX 25046 M.S. 963  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

February 23, 1995

IN REPLY REFER TO:

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Re: USGS TRIGA Reactor Facility  
Docket No. 50-274, License R-113

Gentlemen:

This letter is in response to your request for additional information dated March 11, 1994, concerning the use of TRIGA 12 w% fuel at the USGS TRIGA facility.

Since our initial application, we have found new information and acquired new analytical methods for evaluating the safety of using 12 w% fuel. Informal information from analyses performed by the McClellan Air Force Base TRIGA facility and the Penn State TRIGA facility indicate that the best parameter to use for ensuring safe fuel operation may be the maximum power production in the individual elements. Although the DNB limit is quite high (54 kW per element), operating data at other facilities indicates that a more conservative limit of 23 kW is needed to prevent long-term swelling of the fuel clad. Based on this data, and our new ability to calculate the power production for each fuel element, we propose to limit the calculated power production in all fuel elements to no more than 22 kW per element.

The information in the following pages is referenced to the numbered questions in your March 11 letter.

If you have any questions concerning this information, please contact Tim DeBey, the Reactor Supervisor, at (303) 236-4726.

Sincerely,

*Carl Hedge*

Carl Hedge  
Reactor Administrator

Subscribed and sworn to before me  
this 23rd day of February 1995.

Copies to:  
L.J. Callan, USNRC, Region IV  
Tim DeBey, MS 974

*Jane L. Conniff*  
Notary Public

My commission expires  
10-15-96

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1. Our basis for the statement that the onset of film boiling is reached at a power density of 43 kW per element was verbally received from General Atomics personnel. Further investigation shows that this number is conservative. The Safety Analysis Report for the GA Torrey Pines TRIGA Mk II<sup>+</sup> states that a DNB ratio of 1 is achieved at a power density of 54 kW per element (2700 kW / 100 elements X 2.0 peaking factor). (Ref: GA 9064 p.3-45)

2. Radial peaking factors were calculated in 12 w% TRIGA fuel by GA in 1970. This evaluation showed that peaking was worst with a small core made entirely of 12 w% fuel. A 45 element core (insufficient excess to be usable) gave a peaking factor of 1.40 with fuel in the central thimble. A water-filled central thimble would increase the peaking factor in the adjacent B-ring elements by about 6.3%, giving a maximum radial peaking factor of 1.49. GA 9064, p 3-57, gives an axial peaking factor of 1.25 for all TRIGA fuel elements. These factors apply only to a core of 12 w% elements, with the elements all having no burnup.

3. The 60 element core of new 12 w% elements was an estimated operating core size. An MCNP evaluation was performed of a core having 59 elements ( 56 new 12 w% elements and 3 standard fueled follower control rods (FFCR)). This case is with the B, C, D, and E rings fueled and the F and G rings water-filled. The analysis shows the element with the peak power production is in position B-2, with a radial peak of 1.519, giving a peak power of 26.1 kW in that element. This is above our proposed limit of 22 kW, thus we could not use this core configuration.

4. The increase in the fuel temperature is conservatively assumed to be directly proportional to the power density increase. Assuming an ambient temperature of 25 C and a fuel temperature in an 8.5 w% element of 465 C, a delta T of 440 exists. Given a power increase of 35% in a 12 w% element, the resulting fuel temperature is  $(440 \times 1.35) + 25 = 619$  C. Recent

MCNP analyses show that a maximum peak of 15.3 kW per element is possible by adding a new 8.5 w% element to the B-ring of our existing core. Using our proposed limit of 22 kW per element for a new 12 w% element represents a power increase of about 44% instead of 35%. In addition, the reduced prompt negative temperature coefficient would give an additional 17.6% increase (see item 6c). This gives a maximum pulsing fuel temperature of  $(440 * 1.44 * 1.176) + 25 = 770$  C. This is below the 800 C limit in the GSTR technical specifications.

5. As in item 4, the fuel temperature change is directly proportional to the power density increase. The 35% power increase gives a temperature of  $(300 * 1.35) + 25 = 430$  C. However, recent GSTR operating data showed that a new 8.5 w% element in the B-ring operated at 15.3 kW with a fuel temperature ( $\Delta T$ ) of 455 C. The average power for B-ring fuel elements is 13.5 kW. An element operating at 22 kW would then have a fuel temperature of  $(455 * 1.44) + 25 = 680$  C. After 250 MWh of operation, the new 8.5 wt% element had built up enough long-lived fission product poisons to drop the fuel temperature ( $\Delta T$ ) to 360 C. The temperature has stabilized at this level. Therefore, the 680 C temperature for the new 12 w% element would be temporary and would be expected to drop to a level of  $(360 * 1.44) + 25 = 543$  C over several hundred MWh of operation. In any case, the temperatures are well below the 800 C limit of the GSTR technical specifications.

6a. The fuel element geometries, dimensions and heat transfer characteristics are identical for the 8.5 w% and 12 w% elements. The instrumented 12 w% elements have thermocouples that are identical in type and placement as the 8.5 w% elements. The maximum power generation (and maximum fuel temperature) may not occur in an instrumented element. The maximum temperatures given in items 4 and 5 are based on limiting the element power production to 22 kW. This is the most limiting condition. Temperatures in the FFCR will be lower



than similar fuel elements because the FFCR are smaller in diameter, contain less uranium and are seldom fully withdrawn into the active core region. In any case, the FFCR temperatures will not exceed the maximum temperatures given in items 4 and 5.

6b. The temperature displayed from the instrumented element will not be the peak core fuel temperature in most cases since the peak power-producing fuel element will typically not be the instrumented element. This would be due to the instrumented element having a higher burnup, higher fission product poison concentration or less power peaking due to the loading configuration. In a typical mixed core configuration, a 12 w% element in the B or C ring could be producing approximately 35% more power than a 8.5 w% element in the B or C ring. Our technical specifications require measuring the temperature in a B or C ring element for pulsing operations and we would use a 12 w% instrumented element for any pulsing operations involving a mixed core configuration. By limiting the power peaking to 22 kW per element, the maximum fuel temperatures achieved will be as discussed in items 4 and 5, regardless of whether the element is instrumented or not.

6c. The prompt negative temperature coefficient for 8.5 w% fuel is given as  $10 \times 10^{-5}$  and about 55% of that coefficient is from the "cell effect". The "cell effect" of the 12 w% fuel is about 75% of that of the 8.5 w% fuel. This gives a 12 w% coefficient of  $(0.75 \times 5.5 \times 10^{-5}) + 4.5 \times 10^{-5} = 8.5 \times 10^{-5}$ . (GA 7882) Thus the prompt negative temperature coefficient for 12 w% fuel is 85% of the coefficient for the 8.5 w% fuel. This would require an increase of 17.6% in the element fuel temperature to give the same reactivity feedback. This factor is limiting (assumes all 12 w% core) and was included in item 4.



6d. Proposed changes to GSTR Technical Specification.

D. 1. The core shall be an assembly of TRIGA stainless steel clad fuel-moderator elements, nominally 8.5 to 12 wt% uranium, arranged in a close-packed array except for (1) replacement of single individual elements with incore irradiation facilities or control rods; (2) two separated experiment positions in the D through E rings, each occupying a maximum of three fuel element positions. The reflector (excluding experiments and experimental facilities) shall be water or a combination of graphite and water. The reactor shall not be operated in any manner that would cause any fuel element to produce a calculated steady state power level in excess of 22 kW.

D. 3. Fuel temperatures near the core midplane in either the B or C ring of elements shall be continuously recorded during the pulse mode of operation using a standard thermocouple element. The thermocouple element shall be of 12 wt% uranium loading if any 12 wt% loaded elements exist in the core. The reactor shall not be operated in a manner which could cause the measured fuel temperature to exceed 800°C.

7. The table of fission product gases has been amended according to new information. According to GA-9064 (Mk III SAR), only gaseous fission products that are in the space between the fuel and cladding will be released in the event of a fuel clad failure. It also states that the bromine and iodine isotopes will remain dissolved in the reactor tank water for all practical purposes, and less than 10% of fission product gases with half lives < 1 minute will escape from the reactor pool. These isotopes have been omitted from the analyses of airborne activities. This results in only the krypton and xenon isotopes with half lives > 1 minute giving significant contributions to radiation exposure from the reactor room air

following a cladding failure. The table below assumes a 100 element core, a 12 w% element producing 22 kW, a release fraction of  $3.146 \times 10^{-4}$  and a reactor room volume of  $3.48 \times 10^8$  ml. The reactor room concentration is in microcuries per ml. The isotopes listed are the same as those given in the GA safety analysis for the TRIGA Mk III. (Ref: GA-9064)

#### GASEOUS FISSION PRODUCT RELEASE

Isotope	Fission Yield %	Half-life	Activity (Ci) in		Reactor room conc
			Core	12 w% fuel	
Kr-83m	0.544	1.86 h	4560	100	9.0 e-5
Kr-85m	1.01	4.48 h	8460	186	1.7 e-4
Kr-85	0.054	10.5 y	460	10	9.0 e-6
Kr-87	2.76	76 min	23120	509	4.6 e-4
Kr-88	4.38	2.84 h	36700	807	7.3 e-4
Kr-89	5.47	3.15 min	45830	1010	9.1 e-4
Xe-131m	0.03	12.0 d	250	5.5	5.0 e-6
Xe-133m	0.16	2.19 d	1340	29	2.6 e-5
Xe-133	6.62	5.25 d	55400	1220	1.1 e-3
Xe-135m	1.83	15.3 min	15330	337	3.0 e-4
Xe-135	6.3	9.09 h	52780	1160	1.0 e-3
Xe-137	6.17	3.86 min	51700	1140	1.0 e-3
Xe-138	5.49	14.2 min	46000	1010	9.1 e-4
Br-82	0.125	35.3 h	1044	23	0
Br-83	0.51	2.4 h	4270	94	0
Br-84	0.90	31.8 min	7540	166	0
Br-85	1.1	2.87 min	9220	203	0
I-130m	0.51	9.2 min	4280	94	0
I-131	3.1	8.04 d	25970	571	0
I-132	4.38	2.29 h	36700	807	0
I-133	6.9	20.8 h	57800	1270	0
I-134	7.8	52.6 min	65350	1440	0
I-135	6.1	6.585 h	51100	1120	0
I-136	3.1	86 sec	25960	571	0

8. The assumption of a 120 element core is typical of recent operation at the GSTR. MCNP analyses show that, with the addition of new 12 w% fuel, the core must have about 100 elements to stay below the limit of 22 kW per element in an operational core. A larger core would result in a lower power peak. Approximately 100 elements are required in the core to ensure the peak power element is not producing more than 22 kW. In a 100 element core, the worst case peak to average power per element would be approximately 2.2. In the worst case, the average fuel element temperature of an

element producing 22 kW would be  $(655/1.25) + 25 = 549$  C (Peak temp. is 680 C from item 5 and axial peaking is 1.25), the release fraction would rise to  $3.146 \times 10^{-4}$ . (Re: GA E-117-833) This gives an effective increase in the fission product gas release of a factor of 46 over the average element that is producing 10 kW with temperature <350 C.

A number of core configuration analyses results are attached to this document. The data contain the core loading information (12 w% elements are designated as such), the element power peaking factors, the % error calculated for the peaking factors and the maximum power produced per element. Analyses are provided for a 59 element 12 w% core, the current GSTR core, and various mixed-loading cores that have been arranged to enhance power peaking factors in the 12 w% elements.

#### PERSONNEL EXPOSURES FROM RELEASE OF FISSION GASES

Isotope	Occupational doses (mrem)		Public doses (mrem)	
	1 hour stay	6 hour stay	1 hour stay	6 hour stay
Kr-83m	<0.1	<0.1	<0.1	<0.1
Kr-85m	11.0	13.9	<0.1	<0.1
Kr-85	0.1	0.2	<0.1	<0.1
Kr-87	102.5	118.8	0.4	0.5
Kr-88	455	562	1.6	2.0
Kr-89	1385	1385	2.2	2.3
Xe-131m	<0.1	<0.1	<0.1	<0.1
Xe-133m	0.4	0.5	<0.1	<0.1
Xe-133	15.1	20.0	<0.1	0.1
Xe-135m	19.6	19.9	0.1	0.1
Xe-135	133.2	172.5	0.3	0.4
Xe-137	1866	1866	3.0	3.1
Xe-138	127.4	128.7	0.4	0.4

TOTAL DOSE (mrem)						
	Occupational			Public		
	1 hour stay	6 hour stay	Annual CFR Limit	1 hour stay	6 hour stay	Annual CFR Limit
Whole Body	4115	4288	5000	8.0	8.9	100



The exposure from the airborne fission product gases is entirely from external (submersion) exposure. Since the 10CFR20 submersion limits are based on an infinite radius, hemispherical cloud while the reactor room dimensions are quite finite, the occupational dose values given in the tables above are very conservative.

9. The reactor room ventilation has both normal and emergency modes of operation. The normal mode exhausts air at about 900 cfm directly out the stack. The emergency mode is automatically initiated upon the detection of high airborne activity in the reactor room and it exhausts air at about 275 cfm through both a prefilter and HEPA filter. Since the reactor room air volume is approximately  $12,300 \text{ ft}^3$ , the emergency exhaust would move one room's volume of air in 45 minutes. The effective decay constant for the emergency ventilation system is the ventilation flow rate divided by the room volume, or  $(275/12,300) = 0.022$  per minute.

10. The activity of Xe-135 (see table in item 7) was calculated as follows: Xe-135 has a 6.3% yield from thermal fission of U-235. The equation for the saturated activity of a fission product is:

$$A(\text{Ci}) = (3.1 \times 10^{10} / 3.7 \times 10^{10}) * X * Y,$$

where  $3.1 \times 10^{10}$  is fissions/watt-sec,

$3.7 \times 10^{10}$  is decays/sec-Ci,

X is the element power in watts, and

Y is the fission yield.

For Xe-135,  $A = (3.1 \times 10^{10} / 3.7 \times 10^{10}) * 22000 * 0.063$ ,  
or  $A = 1160 \text{ Ci}$  (rounded to 3 significant figures).

11. New information from the GA safety analysis for their TRIGA Mk III (GA-9064) states that the iodine isotopes remain dissolved in the reactor water and will not be released, as was stated in the initial analysis. Therefore, no thyroid doses will result from a fuel clad failure. We do not plan any releases of fission products

to the unrestricted environment; however, our emergency systems have been designed to further reduce the potential small dose that might be received by a member of the public. The emergency ventilation will prevent any particulate daughter products from being discharged and an emergency alarm that actuates with the detection of high airborne activity will evacuate the reactor building and initiate the emergency procedures. The emergency evacuation will cause offsite emergency personnel to respond, causing the area surrounding the reactor building to be secured. This will prevent any personnel from being near the building, further reducing any possible dose to less than the 8.9 mrem given in the table of item 8.

12. The reactor emergency exhaust system is operationally tested each operating day by alarming the air monitor, before reactor operations are started. This is part of the daily checklist that is completed by the reactor operator and health physicist.

13. The 6 hours stay-time was used to give a maximum possible dose, even if personnel did not evacuate the reactor room or move away from the building. This is not considered credible, but it does provide an extreme upper limit that still results in less than 5000 mrem dose (occupational) and 9 mrem dose (public). A credible and more realistic stay time during a fission product release would be 2 minutes in the reactor room and 10 minutes near the building.

The next page is a Technical Specification replacement page.

#### REFERENCES

GA-9064 "Safety Analysis Report for the Torrey Pines TRIGA Mark III Reactor", Gulf General Atomic Inc., January 5, 1970.

GA E-117-833 "The U-ZrH<sub>x</sub> Alloy: It's Properties and Use in TRIGA Fuel", General Atomics Inc., February 1980.

2. The pool water shall be sampled for conductivity at least weekly. Conductivity averaged over a month shall not exceed 5 micromhos per  $\text{cm}^2$ . This item is not applicable if the reactor is completely defueled and the pool level is below the water treatment system intake.

D. Reactor Core

1. The core shall be an assembly of TRIGA stainless steel clad fuel-moderator elements, nominally 8.5 to 12 w% uranium, arranged in a close-packed array except for (1) replacement of single individual elements with incore irradiation facilities or control rods; (2) two separated experiment positions in the D through E rings, each occupying a maximum of three fuel element positions. The reflector (excluding experiments and experimental facilities) shall be water or a combination of graphite and water. The reactor shall not be operated in any manner that would cause any fuel element to produce a calculated steady state power level in excess of 22 kW.
2. The excess reactivity above cold critical, without xenon, shall not exceed 4.9% delta k/k with experiments in place.
3. Fuel temperatures near the core midplane in either the B or C ring of elements shall be continuously recorded during the pulse mode of operation using a standard thermocouple fuel element. The thermocouple element shall be of 12 wt% uranium loading if any 12 wt% loaded elements exist in the core. The reactor shall not be operated in a manner which would cause the measured fuel temperature to exceed  $800^{\circ}\text{C}$ .
4. Power levels during pulse mode operation that exceed 2500 megawatts shall be cause for the reactor to be shut down pending an investigation by the reactor supervisor to determine the reason



## MCNP ANALYSES AT THE GSTR

Core neutronic analyses of the GSTR TRIGA reactor were performed using the Research Reactor Analysis Program (RRAP) from Atom Analysis, Inc. and the Monte Carlo N-Particle Code (MCNP) from the U.S. DOE Radiation Shielding Information Center. The RRAP provides a user friendly interface for using the MCNP code, allowing personnel to quickly build a detailed model of the TRIGA reactor and easily retrieve and interpret the MCNP code output. The RRAP was customized for the GSTR after having been initially benchmarked at the Oregon State University TRIGA reactor.

The GSTR version of the RRAP code show very good agreement with experimentally determined values for neutron flux measurements, reactivity values of fuel and experiments and fuel element power density vs. fuel temperature. The following pages are data from a number of core configurations that were run to show worst case peaking in 12 w% elements or typical operating configurations. It appears that approximately 100 fuel elements will be required in the core to ensure that no element produces more than 22 kW. The physical configuration of the core grid is show in the figure.

The data tables that follow have the details of numerous core configurations that were calculated using RRAP/MCNP. The columns in the tables are described below:

"GRID DESCRIPTION" describes the locations and types of materials in the individual core grid locations. All 12 w% fuel is listed as 12 w/o fuel; all other fuel is 8.5 w%. The fueled follower control rods (FFCR) are indicated as such. The unfueled pulse rod is not listed, but occupies core position C10.

"Serial No." refers the the serial number of the fuel rod in the grid position. In most cases, the existing configuration of the core was used for the 8.5 w% fuel loadings. Most of the listed 12 w% fuel elements have pseudo serial numbers since these elements do not exist at the GSTR facility.

"Power factor" is the peak to average power factor calculated by the MCNP code for the fuel element listed.

"Error" is the absolute error in the calculated peak-to-average power factor calculated by the MCNP code. All calculations were performed with sufficient particles and cycles to keep all errors below 5% (0.05).

"Max power (kW)" is the maximum calculated power being produced in the specified fuel element. This number is calculated by dividing 1000 kW by the number of fuel elements in the core, multiplying this value by the power factor and then multiplying this product by the sum of the error plus 1. For example, given that

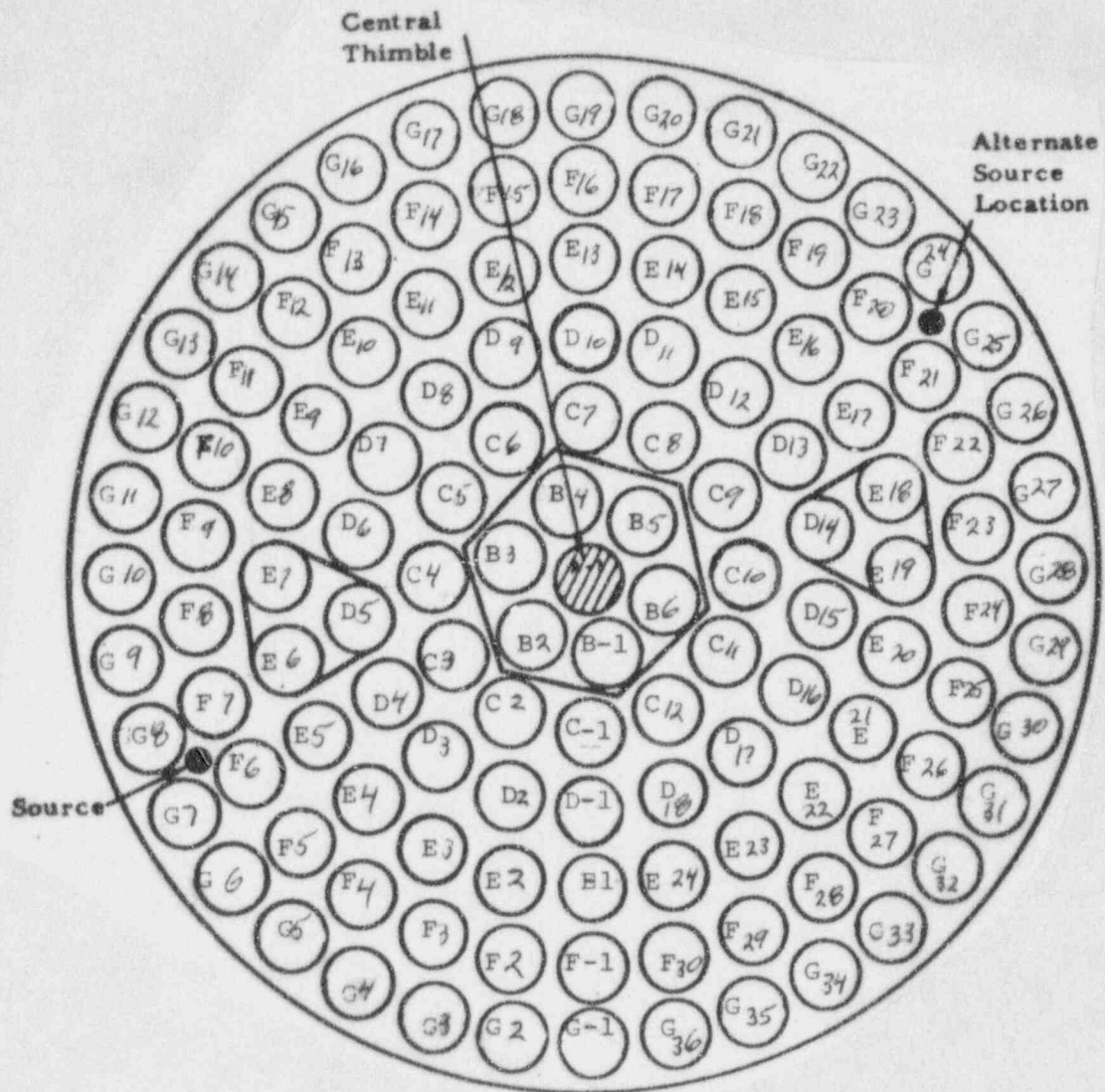
Elements in core = 100,

Power factor = 2.05, and

Error = 0.012, then

Max power =  $(1000/100) * 2.05 * 1.012 = 20.746$  kW

# CORE GRID CONFIGURATION





GSTR REACTOR ANALYSIS  
(base core - 8.5 w%) 125 elements

CASE #1

1

2/9/95

Grid description	Serial No.	Power factor	Error	Max power (kW)
fuel rod #b1	3328	1.66	0.012	13.4394
fuel rod #b2	9304	1.78	0.011	14.3966
fuel rod #b3	3602	1.7	0.011	13.7496
fuel rod #b4	3510	1.65	0.012	13.3584
fuel rod #b5	3701	1.62	0.012	13.1155
fuel rod #b6	6591	1.6	0.012	12.9536
fuel rod #c1	9531	1.39	0.012	11.2534
fuel rod #c11	9842	1.45	0.012	11.7392
fuel rod #c12	9474	1.37	0.012	11.0915
fuel rod #c2	9843	1.52	0.012	12.3059
fuel rod #c3	7932	1.48	0.012	11.9821
FFCR IN #c4	10252	1.66	0.012	13.4394
fuel rod #c5	9532	1.49	0.012	12.0630
fuel rod #c6	7201	1.52	0.012	12.3059
fuel rod #c7	9533	1.44	0.012	11.6582
fuel rod #c8	9841	1.5	0.012	12.1440
fuel rod #c9	3007	1.51	0.012	12.2250
FFCR in #d1	5765	1.06	0.014	8.59872
FFCR in #d10	5980	1.49	0.013	12.0750
fuel rod #d11	7200	1.39	0.012	11.2534
fuel rod #d12	7927	1.32	0.013	10.6973
fuel rod #d13	5007	1.27	0.013	10.2921
fuel rod #d14	3321	1.3	0.013	10.5352
fuel rod #d15	7933	1.22	0.013	9.8869
fuel rod #d16	4096	1.24	0.013	10.0490
fuel rod #d17	5030	1.29	0.013	10.4542
fuel rod #d18	2374	1.27	0.013	10.2921
fuel rod #d2	7928	1.3	0.013	10.5352
fuel rod #d3	7929	1.36	0.012	11.0106
fuel rod #d4	3250	1.33	0.012	10.7677
fuel rod #d5	3695	1.49	0.012	12.0630
fuel rod #d6	7931	1.37	0.012	11.0915
fuel rod #d7	7926	1.35	0.012	10.9296
fuel rod #d8	3134	1.41	0.012	11.4154
fuel rod #d9	7930	1.39	0.012	11.2534
fuel rod #e1	4128	1.11	0.014	9.0043
fuel rod #e10	3017	1.24	0.013	10.0490
fuel rod #e11	3863	1.28	0.013	10.3731
fuel rod #e12	3860	1.29	0.013	10.4542
fuel rod #e13	3116	1.22	0.013	9.8869
fuel rod #e14	2445	1.19	0.013	9.6430
fuel rod #e15	5952	1.24	0.013	10.0490
fuel rod #e16	3022	1.18	0.014	9.5722
fuel rod #e17	3697	1.19	0.014	9.6533
fuel rod #e18	6587	1.2	0.014	9.7344
fuel rod #e19	5751	1.13	0.014	9.1666
fuel rod #e2	6843	1.03	0.014	8.3554
fuel rod #e20	5957	1.08	0.014	8.7610
fuel rod #e21	5699	0.91	0.014	7.3819
fuel rod #e22	5704	0.98	0.014	7.9498
fuel rod #e23	5705	0.96	0.014	7.7875

fuel rod #e24	3361	1.1	0.014	8.9232
fuel rod #e3	6839	1.15	0.014	9.3288
fuel rod #e4	5731	1.17	0.014	9.4910
fuel rod #e5	5755	1.21	0.013	9.8058
fuel rod #e6	5754	1.27	0.013	10.2921
fuel rod #e7	6840	1.29	0.013	10.4542
fuel rod #e8	3857	1.26	0.013	10.2110
fuel rod #e9	5013	1.26	0.013	10.2110
fuel rod #f1	5726	0.77	0.016	6.2586
fuel rod #f10	5759	0.94	0.015	7.6328
fuel rod #f11	5748	0.89	0.015	7.2268
fuel rod #f12	5728	0.89	0.015	7.2268
fuel rod #f13	5735	0.93	0.015	7.5516
fuel rod #f14	5744	0.89	0.015	7.2268
fuel rod #f15	5737	0.89	0.015	7.2268
fuel rod #f16	5716	0.87	0.015	7.0644
fuel rod #f17	5730	0.88	0.015	7.1456
fuel rod #f18	5743	0.87	0.015	7.0644
fuel rod #f19	5740	0.87	0.015	7.0644
fuel rod #f2	5707	0.8	0.016	6.5024
fuel rod #f20	5706	0.87	0.015	7.0644
fuel rod #f21	5731	0.79	0.016	6.4211
fuel rod #f22	5732	0.83	0.016	6.7482
fuel rod #f23	5729	0.84	0.016	6.8275
fuel rod #f24	5753	0.81	0.016	6.5837
fuel rod #f25	5745	0.75	0.016	6.0960
fuel rod #f26	5725	0.77	0.016	6.2586
fuel rod #f27	5747	0.77	0.016	6.2586
fuel rod #f28	5727	0.81	0.016	6.5837
fuel rod #f29	5741	0.82	0.016	6.6650
fuel rod #f3	5717	0.81	0.016	6.5837
fuel rod #f30	5756	0.82	0.016	6.6650
fuel rod #f4	5719	0.85	0.016	6.9088
fuel rod #f5	5734	0.87	0.015	7.0644
fuel rod #f6	5760	0.85	0.015	6.9020
fuel rod #f7	5739	0.89	0.015	7.2268
fuel rod #f8	5708	0.93	0.015	7.5516
fuel rod #f9	5750	0.85	0.015	7.2268
fuel rod #g1	9472	0.62	0.019	5.0542
fuel rod #g10	5720	0.63	0.018	5.1307
fuel rod #g11	5721	0.63	0.018	5.1307
fuel rod #g12	9473	0.67	0.018	5.4565
fuel rod #g13	5736	0.62	0.018	5.0493
fuel rod #g14	5698	0.62	0.018	5.0493
fuel rod #g15	9534	0.68	0.018	5.5379
fuel rod #g16	5701	0.62	0.018	5.0493
fuel rod #g17	7878	0.69	0.017	5.6138
fuel rod #g18	5723	0.63	0.018	5.1307
fuel rod #g19	5682	0.62	0.018	5.0493
fuel rod #g2	5687	0.53	0.019	4.3206
fuel rod #g20	9302	0.65	0.018	5.2936
fuel rod #g21	5681	0.61	0.018	4.9678

## GSTR REACTOR ANALYSIS

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2/9/95

(base core - 8.5 w%) 125 elements

fuel rod #g22	5676	0.63	0.018	5.1307
fuel rod #g23	5689	0.58	0.018	4.7235
fuel rod #g24	5749	0.59	0.018	4.8050
fuel rod #g25	5758	0.59	0.018	4.8050
fuel rod #g26	5688	0.57	0.019	4.6466
fuel rod #g27	5679	0.54	0.019	4.4021
fuel rod #g28	5678	0.56	0.019	4.5651
fuel rod #g29	5684	0.52	0.019	4.2390
fuel rod #g3	5703	0.57	0.019	4.6466
fuel rod #g30	5700	0.52	0.019	4.2390
fuel rod #g31	5686	0.54	0.019	4.4021
fuel rod #g32	5690	0.54	0.019	4.4021
fuel rod #g33	5718	0.55	0.019	4.4836
fuel rod #g34	5685	0.55	0.019	4.4836
fuel rod #g35	5695	0.54	0.019	4.4021
fuel rod #g36	5746	0.58	0.019	4.7282
fuel rod #g4	5683	0.59	0.018	4.8050
fuel rod #g5	5738	0.6	0.018	4.8864
fuel rod #g6	5715	0.6	0.018	4.8864
fuel rod #g7	5762	0.58	0.018	4.7235
fuel rod #g8	5722	0.62	0.018	5.0493
fuel rod #g9	5724	0.6	0.018	4.8864



GSTR REACTOR ANALYSIS  
12 w% in B,C rings 100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	7832	1.98	0.01	19.796
fuel rod 12 w/o #b2	7833	2.07	0.01	20.907
fuel rod 12 w/o #b3	7864	2.06	0.01	20.806
fuel rod 12 w/o #b4	7865	2.01	0.01	20.301
fuel rod 12 w/o #b5	7866	2.05	0.01	20.705
fuel rod 12 w/o #b6	7867	1.9	0.01	19.19
fuel rod #c1	1239	1.7	0.011	17.187
fuel rod #c11	1237	1.71	0.011	17.2881
fuel rod #c12	1238	1.63	0.011	16.4793
fuel rod #c2	1240	1.71	0.011	17.2881
fuel rod #c3	1241	1.77	0.011	17.8947
FFCR #c4	10252	1.45	0.011	14.6595
fuel rod 12 w/o #c5	7868	1.92	0.01	19.392
fuel rod 12 w/o #c6	7869	1.88	0.01	18.988
fuel rod #c7	1234	1.91	0.01	19.291
fuel rod #c8	1235	1.84	0.01	18.584
fuel rod #c9	1236	1.79	0.01	18.079
FFCR #d1	5765	0.85	0.012	8.602
FFCR #d10	5980	1.41	0.011	14.2551
fuel rod #d11	7200	1.29	0.011	13.0419
fuel rod #d12	7927	1.16	0.011	11.7276
fuel rod #d13	5007	1.14	0.011	11.5254
fuel rod #d14	3321	1.16	0.011	11.7276
fuel rod #d15	7933	1.06	0.012	10.7272
fuel rod #d16	4096	1.04	0.012	10.5248
fuel rod #d17	5030	1.05	0.012	10.626
fuel rod #d18	2374	1.04	0.012	10.5248
fuel rod #d2	7928	1.07	0.012	10.8284
fuel rod #d3	7929	1.06	0.012	10.7272
fuel rod #d4	3250	1.09	0.012	11.0308
fuel rod #d5	3695	1.23	0.011	12.4353
fuel rod #d6	7931	1.15	0.011	11.6265
fuel rod #d7	7928	1.15	0.011	11.6265
fuel rod #d8	3134	1.28	0.011	12.9408
fuel rod #d9	7930	1.27	0.011	12.8397
fuel rod #e1	4128	0.87	0.013	8.8131
fuel rod #e10	3017	1.05	0.012	10.626
fuel rod #e11	3863	1.14	0.012	11.5368
fuel rod #e12	3860	1.17	0.012	11.8404
fuel rod #e13	3116	1.18	0.011	11.9298
fuel rod #e14	2445	1.12	0.012	11.3344
fuel rod #e15	5952	1.11	0.012	11.2332
fuel rod #e16	3022	1.03	0.012	10.4236
fuel rod #e17	3697	0.99	0.012	10.0188
fuel rod #e18	6587	0.99	0.012	10.0188
fuel rod #e19	5751	0.93	0.013	9.4209
fuel rod #e2	6843	0.78	0.013	7.9014
fuel rod #e20	5957	0.85	0.013	8.6105
fuel rod #e21	5699	0.71	0.013	7.1923
fuel rod #e22	5704	0.74	0.013	7.4962
fuel rod #e23	5705	0.72	0.014	7.3008

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3381	0.84	0.014	8.5176
fuel rod #e3	6839	0.83	0.013	8.4079
fuel rod #e4	5761	0.85	0.013	8.6105
fuel rod #e5	5755	0.88	0.013	8.9144
fuel rod #e6	5754	0.93	0.013	9.4209
fuel rod #e7	6840	0.98	0.012	9.9176
fuel rod #e8	3857	0.96	0.013	9.7248
fuel rod #e9	5013	1	0.012	10.12
fuel rod #f1	5726	0.57	0.016	5.7912
fuel rod #f10	5759	0.71	0.014	7.1994
fuel rod #f11	5748	0.71	0.014	7.1994
fuel rod #f12	5728	0.73	0.014	7.4022
fuel rod #f13	5735	0.76	0.014	7.7064
fuel rod #f14	5744	0.77	0.013	7.8001
fuel rod #f15	5737	0.77	0.013	7.8001
fuel rod #f16	5716	0.81	0.013	8.2053
fuel rod #f17	5730	0.79	0.013	8.0027
fuel rod #f18	5743	0.78	0.013	7.9014
fuel rod #f19	5740	0.73	0.014	7.4022
fuel rod #f2	5707	0.61	0.015	6.1915
fuel rod #f20	5706	0.7	0.014	7.098
fuel rod #f21	5731	0.67	0.014	6.7938
fuel rod #f22	5732	0.64	0.015	6.496
fuel rod #f23	5729	0.63	0.015	6.3945
fuel rod #f24	5753	0.61	0.015	6.1915
fuel rod #f25	5745	0.59	0.015	5.9885
fuel rod #f26	5725	0.57	0.016	5.7912
fuel rod #f27	5747	0.55	0.016	5.588
fuel rod #f28	5727	0.57	0.016	5.7912
fuel rod #f29	5741	0.56	0.016	5.6896
fuel rod #f3	5717	0.57	0.015	5.7855
fuel rod #f30	5756	0.57	0.016	5.7912
fuel rod #f4	5719	0.58	0.016	5.8928
fuel rod #f5	5734	0.58	0.015	5.887
fuel rod #f6	5760	0.6	0.015	6.09
fuel rod #f7	5739	0.63	0.015	6.3945
fuel rod #f8	5708	0.68	0.015	6.902
fuel rod #f9	5750	0.68	0.015	6.902
water #g1		0		0
water #g10		0		0
water #g11		0		0
water #g12		0		0
water #g13		0		0
fuel rod #g14	5698	0.51	0.016	5.1816
fuel rod #g15	9534	0.54	0.016	5.4864
fuel rod #g16	5701	0.51	0.016	5.1816
fuel rod #g17	7878	0.54	0.016	5.4864
fuel rod #g18	5723	0.53	0.016	5.3848
fuel rod #g19	5682	0.55	0.016	5.588
water #g2		0		0
fuel rod #g20	9302	0.57	0.016	5.7912

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #g21	5681	0.53	0.016	5.3848
fuel rod #g22	5676	0.52	0.016	5.2832
fuel rod #g23	5689	0.48	0.017	4.8816
fuel rod #g24	5749	0.48	0.016	4.8768
water #g25		0		0
water #g26		0		0
water #g27		0		0
water #g28		0		0
water #g29		0		0
water #g3		0		0
water #g30		0		0
water #g31		0		0
water #g32		0		0
water #g33		0		0
water #g34		0		0
water #g35		0		0
water #g36		0		0
water #g4		0		0
water #g5		0		0
water #g6		0		0
water #g7		0		0
water #g8		0		0
water #g9		0		0



GSTR REACTOR ANALYSIS  
12 w% in B,C rings 100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	7832	2.01	0.011	20.3211
fuel rod 12 w/o #b2	7833	2.13	0.011	21.5343
fuel rod 12 w/o #b3	7864	2.08	0.011	21.0288
fuel rod 12 w/o #b4	7865	2.07	0.011	20.9277
fuel rod 12 w/o #b5	7866	2.00	0.011	20.22
fuel rod 12 w/o #b6	7867	1.99	0.011	20.1189
fuel rod #c1	1239	1.77	0.012	17.9124
fuel rod #c11	1237	1.75	0.012	17.71
fuel rod #c12	1238	1.73	0.012	17.5076
fuel rod #c2	1240	1.81	0.012	18.3172
fuel rod #c3	1241	1.84	0.012	18.6208
FFCR #c4	10252	1.48	0.012	14.9776
fuel rod 12 w/o #c5	7868	1.93	0.012	19.5316
fuel rod 12 w/o #c6	7869	1.87	0.012	18.9244
fuel rod #c7	1234	1.86	0.012	18.8232
fuel rod #c8	1235	1.79	0.012	18.1148
fuel rod #c9	1236	1.83	0.012	18.5196
FFCR #d1	5765	0.93	0.014	9.4302
FFCR #d10	5980	1.35	0.013	13.6755
fuel rod #d11	7200	1.24	0.013	12.5612
fuel rod #d12	7927	1.13	0.013	11.4469
fuel rod #d13	5007	1.11	0.013	11.2443
fuel rod #d14	3321	1.16	0.013	11.7508
fuel rod #d15	7933	1.05	0.013	10.6365
fuel rod #d16	4096	1.08	0.013	10.9404
fuel rod #d17	5030	1.08	0.013	10.9404
fuel rod #d18	2374	1.12	0.013	11.3456
fuel rod #d2	7928	1.15	0.013	11.6495
fuel rod #d3	7929	1.15	0.013	11.6495
fuel rod #d4	3250	1.15	0.013	11.6495
fuel rod #d5	3695	1.32	0.012	13.3584
fuel rod #d6	7931	1.18	0.013	11.9534
fuel rod #d7	7926	1.14	0.013	11.5482
fuel rod #d8	3134	1.22	0.012	12.3464
fuel rod #d9	7930	1.20	0.013	12.156
fuel rod #e1	4128	0.94	0.014	9.5316
fuel rod #e10	3017	0.98	0.014	9.9372
fuel rod #e11	3863	1.04	0.014	10.5456
fuel rod #e12	3860	1.05	0.014	10.647
fuel rod #e13	3116	0.99	0.014	10.0386
fuel rod #e14	2445	0.98	0.014	9.9372
fuel rod #e15	5952	1.02	0.014	10.3428
fuel rod #e16	3022	0.95	0.014	9.633
fuel rod #e17	3697	0.96	0.015	9.744
fuel rod #e18	6587	0.94	0.015	9.541
fuel rod #e19	5751	0.93	0.014	9.4302
fuel rod #e2	6843	0.84	0.015	8.526
fuel rod #e20	5957	0.91	0.015	9.2365
fuel rod #e21	5699	0.77	0.015	7.8155
fuel rod #e22	5704	0.75	0.015	7.6125
fuel rod #e23	5705	0.75	0.015	7.6125

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	0.89	0.015	9.0335
fuel rod #e3	6839	0.90	0.015	9.135
fuel rod #e4	5761	0.97	0.014	9.8358
fuel rod #e5	5755	0.97	0.014	9.8358
fuel rod #e6	5754	0.99	0.014	10.0386
fuel rod #e7	6840	1.05	0.014	10.647
fuel rod #e8	3857	1.02	0.014	10.3428
fuel rod #e9	5013	1.01	0.014	10.2414
fuel rod #f1	5726	0.60	0.018	6.108
fuel rod #f10	5759	0.74	0.016	7.5184
fuel rod #f11	5748	0.69	0.016	7.0104
fuel rod #f12	5728	0.71	0.016	7.2136
fuel rod #f13	5735	0.70	0.016	7.112
fuel rod #f14	5744	0.71	0.017	7.2207
fuel rod #f15	5737	0.69	0.016	7.0104
fuel rod #f16	5716	0.66	0.017	6.7122
fuel rod #f17	5730	0.71	0.016	7.2136
fuel rod #f18	5743	0.65	0.017	6.6105
fuel rod #f19	5740	0.64	0.017	6.5088
fuel rod #f2	5707	0.63	0.017	6.4071
fuel rod #f20	5706	0.65	0.017	6.6105
fuel rod #f21	5731	0.60	0.018	6.108
fuel rod #f22	5732	0.65	0.017	6.6105
fuel rod #f23	5729	0.63	0.017	6.4071
fuel rod #f24	5753	0.62	0.017	6.3054
fuel rod #f25	5745	0.64	0.017	6.5088
fuel rod #f26	5725	0.58	0.018	5.9044
fuel rod #f27	5747	0.59	0.017	6.0003
fuel rod #f28	5727	0.60	0.017	6.102
fuel rod #f29	5741	0.60	0.017	6.102
fuel rod #f3	5717	0.63	0.017	6.4071
fuel rod #f30	5756	0.65	0.017	6.6105
fuel rod #f4	5719	0.66	0.017	6.7122
fuel rod #f5	5734	0.70	0.016	7.112
fuel rod #f6	5760	0.64	0.017	6.5088
fuel rod #f7	5739	0.69	0.016	7.0104
fuel rod #f8	5708	0.70	0.016	7.112
fuel rod #f9	5750	0.73	0.016	7.4168
fuel rod #g1	9472	0.45	0.02	4.59
fuel rod #g10	5720	0.48	0.019	4.8912
water #g11		0		0
water #g12		0		0
fuel rod #g13	5736	0.48	0.019	4.8912
water #g14		0		0
water #g15		0		0
fuel rod #g16	5701	0.48	0.019	4.8912
water #g17		0		0
water #g18		0		0
fuel rod #g19	5682	0.47	0.02	4.794
water #g2		0		0
water #g20		0		0

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
water #g21		0		0
fuel rod #g22	5678	0.48	0.019	4.8912
water #g23		0		0
water #g24		0		0
fuel rod #g25	5758	0.45	0.02	4.59
water #g26		0		0
water #g27		0		0
fuel rod #g28	5678	0.41	0.021	4.1861
water #g29		0		0
water #g3		0		0
water #g30		0		0
fuel rod #g31	5686	0.41	0.021	4.1861
water #g32		0		0
water #g33		0		0
water #g34		0		0
water #g35		0		0
water #g36		0		0
fuel rod #g4	5683	0.44	0.02	4.488
water #g5		0		0
water #g6		0		0
fuel rod #g7	5683	0.45	0.02	4.59
water #g8		0		0
water #g9		0		0



GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	7832	1.95	0.009	22.107
fuel rod 12 w/o #b2	7833	2.01	0.009	22.788
fuel rod 12 w/o #b3	7864	1.98	0.009	22.448
fuel rod 12 w/o #b4	7865	1.95	0.009	22.107
fuel rod 12 w/o #b5	7866	1.97	0.009	22.334
fuel rod 12 w/o #b6	7867	1.91	0.01	21.675
fuel rod #c1	1239	1.73	0.01	19.633
fuel rod #c11	1237	1.7	0.01	19.292
fuel rod #c12	1238	1.66	0.01	18.838
fuel rod #c2	1240	1.69	0.01	19.179
fuel rod #c3	1241	1.72	0.01	19.519
FFCR #c4	10252	1.4	0.011	15.903
fuel rod 12 w/o #c5	7868	1.76	0.01	19.973
fuel rod 12 w/o #c6	7869	1.74	0.01	19.746
fuel rod #c7	1234	1.74	0.01	19.746
fuel rod #c8	1235	1.72	0.01	19.519
fuel rod #c9	1236	1.72	0.01	19.519
FFCR #d1	5765	0.88	0.012	10.006
FFCR #d10	5980	1.24	0.011	14.086
fuel rod #d11	7200	1.16	0.011	13.177
fuel rod #d12	7927	1.07	0.011	12.155
fuel rod #d13	5007	1.05	0.011	11.928
fuel rod #d14	3321	1.15	0.011	13.064
fuel rod #d15	7933	1.04	0.011	11.814
fuel rod #d16	4096	1.06	0.011	12.041
fuel rod #d17	5030	1.07	0.011	12.155
fuel rod #d18	2374	1.07	0.011	12.155
fuel rod #d2	7928	1.08	0.011	12.268
fuel rod #d3	7929	1.08	0.011	12.268
fuel rod #d4	3250	1.08	0.011	12.268
fuel rod #d5	3695	1.21	0.011	13.745
fuel rod #d6	7931	1.11	0.011	12.609
fuel rod #d7	7926	1.07	0.011	12.155
fuel rod #d8	3134	1.15	0.011	13.064
fuel rod #d9	7930	1.1	0.011	12.496
fuel rod #e1	4128	0.87	0.012	9.893
fuel rod #e10	3017	0.9	0.012	10.234
fuel rod #e11	3863	0.92	0.012	10.461
fuel rod #e12	3860	0.92	0.012	10.461
fuel rod #e13	3116	0.91	0.012	10.347
fuel rod #e14	2445	0.89	0.012	10.120
fuel rod #e15	5952	0.91	0.012	10.347
fuel rod #e16	3022	0.89	0.012	10.120
fuel rod #e17	3697	0.92	0.012	10.461
fuel rod #e18	6587	0.9	0.012	10.234
fuel rod #e19	5751	0.87	0.012	9.893
fuel rod #e2	6843	0.82	0.013	9.333
fuel rod #e20	5957	0.83	0.013	9.447
fuel rod #e21	5699	0.71	0.013	8.081
fuel rod #e22	5704	0.73	0.013	8.309
fuel rod #e23	5705	0.72	0.013	8.195

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	0.86	0.013	9.789
fuel rod #e3	9839	0.86	0.012	9.779
fuel rod #e4	5761	0.87	0.012	9.893
fuel rod #e5	5755	0.84	0.012	9.551
fuel rod #e6	5754	0.9	0.012	10.234
fuel rod #e7	8840	0.94	0.012	10.689
fuel rod #e8	3857	0.91	0.012	10.347
fuel rod #e9	5013	0.93	0.012	10.575
fuel rod #f1	5726	0.58	0.015	6.615
fuel rod #f10	5759	0.63	0.014	7.178
fuel rod #f11	5748	0.62	0.014	7.064
fuel rod #f12	5728	0.62	0.014	7.064
fuel rod #f13	5735	0.63	0.014	7.178
fuel rod #f14	5744	0.63	0.014	7.178
fuel rod #f15	5737	0.62	0.014	7.064
fuel rod #f16	5716	0.61	0.014	6.950
fuel rod #f17	5730	0.61	0.014	6.950
fuel rod #f18	5743	0.62	0.014	7.064
fuel rod #f19	5740	0.63	0.014	7.178
fuel rod #f2	5707	0.6	0.014	6.836
fuel rod #f20	5706	0.62	0.014	7.064
fuel rod #f21	5731	0.58	0.015	6.615
fuel rod #f22	5732	0.58	0.015	6.615
fuel rod #f23	5729	0.59	0.015	6.729
fuel rod #f24	5753	0.6	0.015	6.843
fuel rod #f25	5745	0.59	0.015	6.729
fuel rod #f26	5725	0.58	0.015	6.615
fuel rod #f27	5747	0.56	0.015	6.387
fuel rod #f28	5727	0.59	0.015	6.729
fuel rod #f29	5741	0.56	0.015	6.387
fuel rod #f3	5717	0.6	0.014	6.836
fuel rod #f30	5756	0.59	0.015	6.729
fuel rod #f4	5719	0.61	0.014	6.950
fuel rod #f5	5734	0.61	0.014	6.950
fuel rod #f6	5760	0.61	0.014	6.950
fuel rod #f7	5739	0.61	0.014	6.950
fuel rod #f8	5708	0.64	0.014	7.292
fuel rod #f9	5750	0.63	0.014	7.178
water #g1		0		0.000
water #g10		0		0.000
water #g11		0		0.000
water #g12		0		0.000
water #g13		0		0.000
water #g14		0		0.000
water #g15		0		0.000
water #g16		0		0.000
water #g17		0		0.000
water #g18		0		0.000
water #g19		0		0.000
water #g2		0		0.000
water #g20		0		0.000

12 w% in B,C rings

89 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
water #g21		0		0.000
water #g22		0		0.000
water #g23		0		0.000
water #g24		0		0.000
water #g25		0		0.000
water #g26		0		0.000
water #g27		0		0.000
water #g28		0		0.000
water #g29		0		0.000
water #g3		0		0.000
water #g30		0		0.000
water #g31		0		0.000
water #g32		0		0.000
water #g33		0		0.000
water #g34		0		0.000
water #g35		0		0.000
water #g36		0		0.000
water #g4		0		0.000
water #g5		0		0.000
water #g6		0		0.000
water #g7		0		0.000
water #g8		0		0.000
water #g9		0		0.000



## GSTR REACTOR ANALYSIS

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12 w% in B,C rings

89 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	7832	2.01	0.009	22.788
fuel rod 12 w/o #b2	7833	2.05	0.009	23.241
fuel rod 12 w/o #b3	7864	2.04	0.009	23.128
fuel rod 12 w/o #b4	7865	2.03	0.009	23.014
fuel rod 12 w/o #b5	7866	1.98	0.009	22.448
fuel rod 12 w/o #b6	7867	1.95	0.009	22.107
fuel rod #c1	9531	1.24	0.01	14.072
fuel rod #c11	9842	1.28	0.01	14.526
fuel rod #c12	9474	1.18	0.011	13.404
fuel rod #c2	9843	1.3	0.01	14.753
fuel rod #c3	10038	1.49	0.01	16.909
FFCR #c4	10252	1.46	0.011	16.585
fuel rod 12 w/o #c5	7868	1.88	0.01	21.335
fuel rod 12 w/o #c6	7869	1.84	0.01	20.881
fuel rod #c7	1234	1.86	0.01	21.108
fuel rod #c8	1235	1.81	0.01	20.541
fuel rod #c9	1236	1.79	0.01	20.314
FFCR #d1	5765	0.85	0.012	9.665
FFCR #d10	5980	1.3	0.011	14.767
fuel rod #d11	7200	1.23	0.011	13.972
fuel rod #d12	7927	1.17	0.011	13.291
fuel rod #d13	5007	1.13	0.011	12.836
fuel rod #d14	3321	1.15	0.011	13.064
fuel rod #d15	7933	1.01	0.011	11.473
fuel rod #d16	4096	1.02	0.011	11.587
fuel rod #d17	5030	1.03	0.012	11.712
fuel rod #d18	2374	1.02	0.011	11.587
fuel rod #d2	7928	1.07	0.011	12.155
fuel rod #d3	7929	1.08	0.011	12.268
fuel rod #d4	3250	1.1	0.011	12.496
fuel rod #d5	3695	1.23	0.011	13.972
fuel rod #d6	7931	1.17	0.011	13.291
fuel rod #d7	7926	1.12	0.011	12.723
fuel rod #d8	3134	1.21	0.011	13.745
fuel rod #d9	7930	1.19	0.011	13.518
fuel rod #e1	4128	0.81	0.013	9.219
fuel rod #e10	3017	0.94	0.012	10.689
fuel rod #e11	3863	1.03	0.012	11.712
fuel rod #e12	3860	0.99	0.012	11.257
fuel rod #e13	3116	0.96	0.012	10.916
fuel rod #e14	2445	0.96	0.012	10.916
fuel rod #e15	5952	0.97	0.012	11.030
fuel rod #e16	3022	0.84	0.012	10.689
fuel rod #e17	3697	0.96	0.012	10.916
fuel rod #e18	6567	0.94	0.012	10.689
fuel rod #e19	5751	0.87	0.012	9.893
fuel rod #e2	6843	0.77	0.013	8.764
fuel rod #e20	5957	0.81	0.013	9.219
fuel rod #e21	5699	0.69	0.013	7.854
fuel rod #e22	5704	0.69	0.013	7.854
fuel rod #e23	5705	0.67	0.013	7.626

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	0.79	0.013	8.992
fuel rod #e3	6839	0.84	0.013	9.561
fuel rod #e4	5761	0.84	0.013	9.561
fuel rod #e5	5755	0.87	0.012	9.893
fuel rod #e6	5754	0.94	0.012	10.689
fuel rod #e7	6840	0.97	0.012	11.030
fuel rod #e8	5857	0.97	0.012	11.030
fuel rod #e9	5013	0.96	0.012	10.916
fuel rod #f1	5726	0.54	0.015	6.158
fuel rod #f10	5759	0.69	0.014	7.861
fuel rod #f11	5748	0.66	0.014	7.520
fuel rod #f12	5728	0.68	0.014	7.747
fuel rod #f13	5735	0.69	0.014	7.861
fuel rod #f14	5744	0.68	0.014	7.747
fuel rod #f15	5737	0.57	0.014	7.634
fuel rod #f16	5716	0.66	0.014	7.520
fuel rod #f17	5730	0.65	0.014	7.406
fuel rod #f18	5743	0.67	0.014	7.634
fuel rod #f19	5740	0.66	0.014	7.520
fuel rod #f2	5707	0.55	0.015	6.272
fuel rod #f20	5706	0.66	0.014	7.520
fuel rod #f21	5731	0.63	0.014	7.178
fuel rod #f22	5732	0.63	0.014	7.178
fuel rod #f23	5729	0.61	0.014	6.950
fuel rod #f24	5753	0.6	0.015	6.843
fuel rod #f25	5745	0.57	0.015	6.501
fuel rod #f26	5725	0.55	0.015	6.272
fuel rod #f27	5747	0.54	0.015	6.158
fuel rod #f28	5727	0.55	0.015	6.272
fuel rod #f29	5741	0.54	0.015	6.158
fuel rod #f3	5717	0.57	0.015	6.501
fuel rod #f30	5756	0.56	0.015	6.387
fuel rod #f4	5719	0.58	0.015	6.615
fuel rod #f5	5734	0.59	0.015	6.729
fuel rod #f6	5760	0.58	0.015	6.615
fuel rod #f7	5739	0.61	0.014	6.950
fuel rod #f8	5708	0.67	0.014	7.634
fuel rod #f9	5750	0.69	0.014	7.861
water #g1		0		0.000
water #g10		0		0.000
water #g11		0		0.000
water #g12		0		0.000
water #g13		0		0.000
water #g14		0		0.000
water #g15		0		0.000
water #g16		0		0.000
water #g17		0		0.000
water #g18		0		0.000
water #g19		0		0.000
water #g2		0		0.000
water #g20		0		0.000

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
water #g21		0		0.000
water #g22		0		0.000
water #g23		0		0.000
water #g24		0		0.000
water #g25		0		0.000
water #g26		0		0.000
water #g27		0		0.000
water #g28		0		0.000
water #g29		0		0.000
water #g3		0		0.000
water #g30		0		0.000
water #g31		0		0.000
water #g32		0		0.000
water #g33		0		0.000
water #g34		0		0.000
water #g35		0		0.000
water #g36		0		0.000
water #g4		0		0.000
water #g5		0		0.000
water #g6		0		0.000
water #g7		0		0.000
water #g8		0		0.000
water #g9		0		0.000



## GSTR REACTOR ANALYSIS

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2/14/95

New 8.5 wt % element in b2

124 elements

Grid description	Serial No.	Power factor	Error	Max power (kW)
fuel rod #b1	3328	1.73	0.011	14.1059
fuel rod #b2	9304	1.87	0.011	15.2474
fuel rod #b3	3692	1.76	0.01	14.3363
fuel rod #b4	3510	1.67	0.011	13.6167
fuel rod #b5	3701	1.65	0.011	13.4536
fuel rod #b6	6591	1.65	0.011	13.4536
fuel rod #c1	9531	1.46	0.011	11.9044
fuel rod #c1	9842	1.43	0.011	11.6598
fuel rod #c1	9474	1.39	0.011	11.3337
fuel rod #c2	9843	1.54	0.011	12.5567
fuel rod #c3	7932	1.52	0.011	12.3936
FFCR in #c4	10252	1.67	0.012	13.6302
fuel rod #c5	9532	1.49	0.011	12.149
fuel rod #c6	7201	1.53	0.011	12.4752
fuel rod #c7	9533	1.47	0.011	11.986
fuel rod #c8	9841	1.45	0.011	11.8229
fuel rod #c9	3007	1.49	0.011	12.149
FFCR in #d1	5765	1.06	0.013	8.66
FFCR in #d10	5980	1.45	0.012	11.8346
fuel rod #d1	7200	1.34	0.012	10.9368
fuel rod #d1	7927	1.3	0.012	10.6103
fuel rod #d1	5007	1.3	0.012	10.6103
fuel rod #d1	3321	1.31	0.012	10.6919
fuel rod #d1	7933	1.22	0.012	9.9574
fuel rod #d1	4096	1.23	0.012	10.039
fuel rod #d1	5030	1.3	0.012	10.6103
fuel rod #d1	2374	1.3	0.012	10.6103
fuel rod #d2	7928	1.38	0.012	11.2633
fuel rod #d3	7929	1.35	0.012	11.0184
fuel rod #d4	3250	1.38	0.012	11.2633
fuel rod #d5	3695	1.48	0.011	12.0675
fuel rod #d6	7931	1.36	0.012	11.1
fuel rod #d7	7926	1.34	0.012	10.9368
fuel rod #d8	3134	1.43	0.012	11.6713
fuel rod #d9	7930	1.34	0.012	10.9368
fuel rod #e1	4128	1.17	0.013	9.5587
fuel rod #e1	3017	1.19	0.013	9.7221
fuel rod #e1	3863	1.19	0.013	9.7221
fuel rod #e1	3860	1.15	0.013	9.3953
fuel rod #e1	3116	1.16	0.013	9.477
fuel rod #e1	2445	1.14	0.013	9.3136
fuel rod #e1	5952	1.18	0.013	9.6404
fuel rod #e1	3022	1.14	0.013	9.3136
fuel rod #e1	3697	1.17	0.013	9.5587
fuel rod #e1	6587	1.21	0.013	9.8855
fuel rod #e1	5751	1.12	0.013	9.1502
fuel rod #e2	6843	1.09	0.013	8.9051
fuel rod #e2	5957	1.07	0.013	8.7417
fuel rod #e2	5699	0.92	0.013	7.5163
fuel rod #e2	5704	0.96	0.013	7.8431
fuel rod #e2	5705	0.96	0.013	7.8431

New 8.5 wt % element in b2

124 elements

Grid description	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e2	3361	1.13	0.013	9.2319
fuel rod #e3	6839	1.19	0.013	9.7221
fuel rod #e4	5761	1.19	0.012	9.7125
fuel rod #e5	5755	1.21	0.012	9.8758
fuel rod #e6	5754	1.3	0.012	10.6103
fuel rod #e7	6840	1.3	0.012	10.6103
fuel rod #e8	3857	1.27	0.012	10.3655
fuel rod #e9	5013	1.23	0.012	10.039
fuel rod #f1	5726	0.81	0.015	6.6306
fuel rod #f1	5759	0.92	0.014	7.5237
fuel rod #f1	5748	0.88	0.014	7.1966
fuel rod #f1	5728	0.88	0.014	7.1966
fuel rod #f1	5735	0.84	0.015	6.8762
fuel rod #f1	5744	0.72	0.016	5.8997
fuel rod #f1	5737	0.74	0.016	6.0636
fuel rod #f1	5716	0.81	0.015	6.6306
fuel rod #f1	5730	0.84	0.014	6.8694
fuel rod #f1	5743	0.83	0.015	6.7944
fuel rod #f1	5740	0.81	0.015	6.6306
fuel rod #f2	5707	0.87	0.014	7.1148
fuel rod #f2	5706	0.82	0.015	6.7125
fuel rod #f2	5731	0.8	0.015	6.5488
fuel rod #f2	5732	0.84	0.015	6.8762
fuel rod #f2	5729	0.85	0.015	6.9581
fuel rod #f2	5753	0.82	0.015	6.7125
fuel rod #f2	5745	0.81	0.015	6.6306
fuel rod #f2	5725	0.78	0.015	6.3851
fuel rod #f2	5747	0.79	0.015	6.4669
fuel rod #f2	5727	0.82	0.015	6.7125
fuel rod #f2	5741	0.81	0.015	6.6306
fuel rod #f3	5717	0.86	0.014	7.033
fuel rod #f3	5756	0.82	0.015	6.7125
fuel rod #f4	5719	0.88	0.014	7.1966
fuel rod #f5	5734	0.89	0.014	7.2783
fuel rod #f6	5760	0.97	0.014	7.1148
fuel rod #f7	5739	0.93	0.014	7.6055
fuel rod #f8	5708	0.95	0.014	7.769
fuel rod #f9	5750	0.95	0.014	7.769
fuel rod #g1	9472	0.6	0.017	4.9213
fuel rod #g1	5720	0.66	0.016	5.4081
fuel rod #g1	5721	0.62	0.017	5.0853
fuel rod #g1	9473	0.67	0.016	5.49
fuel rod #g1	5736	0.61	0.017	5.0033
fuel rod #g1	5698	0.59	0.017	4.8392
fuel rod #g1	9534	0.62	0.017	5.0853
fuel rod #g1	5701	0.47	0.019	3.8626
Cd terminus #g17				0
fuel rod #g1	5723	0.47	0.019	3.8626
fuel rod #g1	5682	0.55	0.018	4.5156
fuel rod #g2	5687	0.59	0.017	4.8392
fuel rod #g2	9302	0.61	0.017	5.0033

New 8.5 wt % element in b2

124 elements

Grid description	Serial No.	Power factor	Error	Max power (kW)
fuel rod #g2	5681	0.59	0.017	4.8392
fuel rod #g2	5676	0.59	0.017	4.8392
fuel rod #g2	5689	0.57	0.017	4.6752
fuel rod #g2	5749	0.58	0.017	4.7572
fuel rod #g2	5758	0.61	0.017	5.0033
fuel rod #g2	5688	0.58	0.017	4.7572
fuel rod #g2	5679	0.55	0.017	4.5112
fuel rod #g2	5678	0.55	0.018	4.5156
fuel rod #g2	5684	0.56	0.017	4.5932
fuel rod #g3	5703	0.63	0.017	5.1673
fuel rod #g3	5700	0.54	0.018	4.4335
fuel rod #g3	5686	0.52	0.018	4.2693
fuel rod #g3	5690	0.53	0.017	4.3471
fuel rod #g3	5718	0.57	0.017	4.6752
fuel rod #g3	5685	0.56	0.018	4.5977
fuel rod #g3	5695	0.56	0.018	4.5977
fuel rod #g3	5746	0.56	0.017	4.5932
fuel rod #g4	5683	0.63	0.016	5.1622
fuel rod #g5	5738	0.63	0.016	5.1622
fuel rod #g6	5715	0.62	0.017	5.0853
fuel rod #g7	5762	0.6	0.017	4.9213
fuel rod #g8	5722	0.61	0.017	5.0033
fuel rod #g9	5724	0.66	0.016	5.4081



## GSTR REACTOR ANALYSIS

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2/16/95

All 12 wt% core except FFCR

59 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	1111	1.46	0.013	25.0672
fuel rod 12 w/o #b2	1111	1.52	0.012	26.0716
fuel rod 12 w/o #b3	1111	1.51	0.012	25.9001
fuel rod 12 w/o #b4	1111	1.48	0.012	25.3855
fuel rod 12 w/o #b5	1111	1.5	0.012	25.7286
fuel rod 12 w/o #b6	1111	1.49	0.012	25.5571
fuel rod 12 w/o #c1	1111	1.28	0.014	21.9984
fuel rod 12 w/o #c11	1111	1.23	0.014	21.1391
fuel rod 12 w/o #c12	1111	1.23	0.014	21.1391
fuel rod 12 w/o #c2	1111	1.22	0.014	20.9673
fuel rod 12 w/o #c3	1111	1.27	0.014	21.8266
FFCR in #c4	10252	1.04	0.015	17.8914
fuel rod 12 w/o #c5	1111	1.32	0.013	22.6635
fuel rod 12 w/o #c6	1111	1.26	0.014	21.6547
fuel rod 12 w/o #c7	1111	1.3	0.013	22.3201
fuel rod 12 w/o #c8	1111	1.25	0.014	21.4829
fuel rod 12 w/o #c9	1111	1.23	0.014	21.1391
FFCR in #d1	5765	0.61	0.016	10.5043
FFCR in #d10	5980	0.84	0.016	14.4650
fuel rod 12 w/o #d11	1111	1.03	0.015	17.7193
fuel rod 12 w/o #d12	1111	1.01	0.015	17.3753
fuel rod 12 w/o #d13	1111	0.95	0.016	16.3592
fuel rod 12 w/o #d14	1111	1.02	0.015	17.5473
fuel rod 12 w/o #d15	1111	0.94	0.016	16.1870
fuel rod 12 w/o #d16	1111	0.96	0.016	16.5314
fuel rod 12 w/o #d17	1111	0.99	0.015	17.0312
fuel rod 12 w/o #d18	1111	1.04	0.015	17.8914
fuel rod 12 w/o #d2	1111	0.99	0.015	17.0312
fuel rod 12 w/o #d3	1111	0.97	0.015	16.6871
fuel rod 12 w/o #d4	1111	0.97	0.015	16.6871
fuel rod 12 w/o #d5	1111	1.04	0.015	17.8914
fuel rod 12 w/o #d6	1111	0.99	0.015	17.0312
fuel rod 12 w/o #d7	1111	1.01	0.015	17.3753
fuel rod 12 w/o #d8	1111	0.98	0.015	16.8592
fuel rod 12 w/o #d9	1111	1.01	0.015	17.3753
fuel rod 12 w/o #e1	1111	0.8	0.017	13.7897
fuel rod 12 w/o #e10	1111	0.84	0.017	14.4792
fuel rod 12 w/o #e11	1111	0.8	0.017	13.7897
fuel rod 12 w/o #e12	1111	0.8	0.017	13.7897
fuel rod 12 w/o #e13	1111	0.81	0.017	13.9621
fuel rod 12 w/o #e14	1111	0.81	0.017	13.9621
fuel rod 12 w/o #e15	1111	0.78	0.017	13.4450
fuel rod 12 w/o #e16	1111	0.78	0.017	13.4450
fuel rod 12 w/o #e17	1111	0.76	0.017	13.1002
fuel rod 12 w/o #e18	1111	0.8	0.017	13.7897
fuel rod 12 w/o #e19	1111	0.77	0.017	13.2726
fuel rod 12 w/o #e2	1111	0.75	0.017	12.9278
fuel rod 12 w/o #e20	1111	0.76	0.017	13.1002
fuel rod 12 w/o #e21	1111	0.78	0.017	13.4450
fuel rod 12 w/o #e22	1111	0.79	0.017	13.6173
fuel rod 12 w/o #e23	1111	0.8	0.017	13.7897

All 12 wt% core except FFCR 59 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #e24	1111	0.81	0.017	13.9621
fuel rod 12 w/o #e3	1111	0.78	0.017	13.4450
fuel rod 12 w/o #e4	1111	0.8	0.017	13.7897
fuel rod 12 w/o #e5	1111	0.79	0.017	13.6173
fuel rod 12 w/o #e6	1111	0.84	0.017	14.4792
fuel rod 12 w/o #e7	1111	0.84	0.016	14.4650
fuel rod 12 w/o #e8	1111	0.78	0.017	13.4450
fuel rod 12 w/o #e9	1111	0.78	0.017	13.4450

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #b1	3328	1.64	0.011	13.3721
fuel rod 12 w/o #b2	1234	2.22	0.01	18.0833
fuel rod #b3	3692	1.68	0.011	13.6982
fuel rod #b4	3510	1.72	0.011	14.0244
fuel rod #b5	3701	1.65	0.011	13.4536
fuel rod #b6	8591	1.64	0.011	13.3721
fuel rod #c1	9531	1.48	0.011	12.0675
fuel rod #c11	9842	1.5	0.011	12.2306
fuel rod #c12	9474	1.47	0.011	11.9860
fuel rod #c2	9843	1.52	0.011	12.3936
fuel rod #c3	7932	1.44	0.011	11.7413
FFCR in #c4	10252	1.66	0.012	13.5486
fuel rod #c5	9532	1.51	0.011	12.3121
fuel rod #c6	7201	1.51	0.011	12.3121
fuel rod #c7	9533	1.42	0.011	11.5783
fuel rod #c8	9841	1.48	0.011	12.0675
fuel rod #c9	3007	1.5	0.011	12.2306
FFCR in #d1	5765	1.1	0.012	8.9780
FFCR in #d10	5980	1.45	0.012	11.8346
fuel rod #d11	7200	1.36	0.012	11.1000
fuel rod #d12	7927	1.29	0.012	10.5287
fuel rod #d13	5007	1.29	0.012	10.5287
fuel rod #d14	3321	1.34	0.012	10.9368
fuel rod #d15	7933	1.27	0.012	10.3655
fuel rod #d16	4096	1.31	0.012	10.6919
fuel rod #d17	5030	1.35	0.012	11.0184
fuel rod #d18	2374	1.31	0.012	10.6919
fuel rod #d2	7928	1.36	0.012	11.1000
fuel rod #d3	7929	1.36	0.012	11.1000
fuel rod #d4	3250	1.34	0.012	10.9368
fuel rod #d5	3695	1.47	0.012	11.9978
fuel rod #d6	7931	1.34	0.012	10.9368
fuel rod #d7	7926	1.34	0.012	10.9368
fuel rod #d8	3134	1.36	0.012	11.1000
fuel rod #d9	7930	1.32	0.012	10.7735
fuel rod #e1	4128	1.18	0.013	9.6404
fuel rod #e10	3017	1.16	0.013	9.4770
fuel rod #e11	3863	1.16	0.013	9.4770
fuel rod #e12	3860	1.15	0.013	9.3953
fuel rod #e13	3116	1.17	0.013	9.5587
fuel rod #e14	2445	1.14	0.013	9.3136
fuel rod #e15	5952	1.19	0.013	9.7221
fuel rod #e16	3022	1.16	0.013	9.4770
fuel rod #e17	3697	1.18	0.013	9.6404
fuel rod #e18	6587	1.21	0.013	9.8855
fuel rod #e19	5751	1.18	0.012	9.6309
fuel rod #e2	6843	1.08	0.013	8.8234
fuel rod #e20	5957	1.14	0.013	9.3136
fuel rod #e21	5699	0.97	0.013	7.9247
fuel rod #e22	5704	0.97	0.013	7.9247
fuel rod #e23	5705	1.03	0.013	8.4149



12 w/o in B2, others are 8.5

124 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	1.17	0.013	9.5587
fuel rod #e3	6839	1.18	0.013	9.6404
fuel rod #e4	5761	1.17	0.013	9.5587
fuel rod #e5	5755	1.19	0.013	9.7221
fuel rod #e6	5754	1.22	0.012	9.9574
fuel rod #e7	6940	1.24	0.012	10.1206
fuel rod #e8	3857	1.2	0.013	9.8038
fuel rod #e9	5013	1.18	0.013	9.6404
fuel rod #f1	5726	0.82	0.014	6.7059
fuel rod #f10	5759	0.89	0.014	7.2783
fuel rod #f11	5741	0.84	0.015	6.8762
fuel rod #f12	5728	0.84	0.015	6.8762
fuel rod #f13	5735	0.8	0.015	6.5488
fuel rod #f14	5744	0.72	0.016	5.8997
fuel rod #f15	5737	0.74	0.016	6.0636
fuel rod #f16	5716	0.81	0.015	6.6306
fuel rod #f17	5730	0.82	0.015	6.7125
fuel rod #f18	5743	0.86	0.014	7.0330
fuel rod #f19	5740	0.85	0.015	6.9581
fuel rod #f2	5707	0.85	0.014	6.9512
fuel rod #f20	5706	0.87	0.014	7.1148
fuel rod #f21	5731	0.81	0.015	6.6306
fuel rod #f22	5732	0.82	0.015	6.7125
fuel rod #f23	5729	0.86	0.015	7.0399
fuel rod #f24	5753	0.85	0.014	6.9512
fuel rod #f25	5745	0.84	0.014	6.8694
fuel rod #f26	5725	0.82	0.015	6.7125
fuel rod #f27	5747	0.78	0.015	6.3851
fuel rod #f28	5727	0.83	0.015	6.7944
fuel rod #f29	5741	0.82	0.015	6.7125
fuel rod #f3	5717	0.84	0.015	6.8762
fuel rod #f30	5756	0.86	0.015	7.0399
fuel rod #f4	5719	0.86	0.014	7.0330
fuel rod #f5	5734	0.85	0.014	6.9512
fuel rod #f6	5760	0.84	0.014	6.8694
fuel rod #f7	5739	0.86	0.014	7.0330
fuel rod #f8	5708	0.9	0.014	7.3601
fuel rod #f9	5750	0.91	0.014	7.4419
fuel rod #g1	9472	0.63	0.017	5.1673
fuel rod #g10	5720	0.6	0.017	4.9213
fuel rod #g11	5721	0.58	0.017	4.7572
fuel rod #g12	9473	0.63	0.017	5.1673
fuel rod #g13	5736	0.59	0.017	4.8392
fuel rod #g14	5698	0.56	0.017	4.5932
fuel rod #g15	9534	0.6	0.017	4.9213
fuel rod #g16	5701	0.47	0.019	3.8626
Cd terminus (air fill)				0.0000
fuel rod #g18	5723	0.46	0.019	3.7804
fuel rod #g19	5682	0.55	0.018	4.5156
fuel rod #g2	5687	0.58	0.017	4.7572
fuel rod #g20	9302	0.6	0.018	4.9261

## GSTR REACTOR ANALYSIS

3

2/22/95

12 w/o in B2, others are 8.5

124 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #g21	5681	0.59	0.017	4.8392
fuel rod #g22	5678	0.62	0.017	5.0853
fuel rod #g23	5659	0.59	0.017	4.8392
fuel rod #g24	5749	0.57	0.017	4.6752
fuel rod #g25	5758	0.57	0.017	4.6752
fuel rod #g26	5688	0.57	0.017	4.6752
fuel rod #g27	5679	0.59	0.017	4.8392
fuel rod #g28	5678	0.57	0.017	4.6752
fuel rod #g29	5684	0.56	0.017	4.5932
fuel rod #g3	5703	0.63	0.017	5.1673
fuel rod #g30	5700	0.56	0.017	4.5932
fuel rod #g31	5686	0.57	0.017	4.6752
fuel rod #g32	5690	0.56	0.017	4.5932
fuel rod #g33	5718	0.56	0.017	4.5932
fuel rod #g34	5685	0.57	0.017	4.6752
fuel rod #g35	5695	0.58	0.017	4.7572
fuel rod #g36	5746	0.59	0.017	4.8392
fuel rod #g4	5683	0.6	0.017	4.9213
fuel rod #g5	5738	0.6	0.017	4.9213
fuel rod #g6	5715	0.61	0.017	5.0033
fuel rod #g7	5762	0.58	0.017	4.7572
fuel rod #g8	5722	0.6	0.017	4.9213
fuel rod #g9	5724	0.61	0.017	5.0033

## CASE #9

GSTR REACTOR ANALYSIS

1

2/22/05

12 w/o in C2- all else is 8.5 125 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #b1	3328	1.65	0.018	13.4376
fuel rod #b2	9304	1.78	0.018	14.4963
fuel rod #b3	3692	1.73	0.018	14.0891
fuel rod #b4	3510	1.6	0.018	13.0304
fuel rod #b5	3701	1.62	0.018	13.1933
fuel rod #b6	6591	1.57	0.018	12.7861
fuel rod #c1	9531	1.37	0.019	11.1682
fuel rod #c11	9842	1.44	0.019	11.7389
fuel rod #c12	9474	1.35	0.019	11.0052
fuel rod 12 w/o #c2	1234	1.93	0.019	15.7334
fuel rod #c3	7932	1.42	0.019	11.5758
FFCR in #c4	10252	1.64	0.02	13.3824
fuel rod #c5	9532	1.54	0.018	12.5418
fuel rod #c6	7201	1.51	0.019	12.3095
fuel rod #c7	9533	1.42	0.019	11.5758
fuel rod #c8	9841	1.46	0.019	11.9019
fuel rod #c9	3007	1.45	0.019	11.8204
FFCR in #d1	5765	1.04	0.021	8.49472
FFCR in #d10	5980	1.41	0.021	11.5169
fuel rod #d11	7200	1.35	0.02	11.016
fuel rod #d12	7927	1.26	0.02	10.2816
fuel rod #d13	5007	1.26	0.02	10.2816
fuel rod #d14	3321	1.34	0.02	10.9344
fuel rod #d15	7933	1.21	0.02	9.8736
fuel rod #d16	4096	1.26	0.021	10.2917
fuel rod #d17	5030	1.23	0.021	10.0466
fuel rod #d18	2374	1.25	0.02	10.2
fuel rod #d2	7928	1.28	0.02	10.4448
fuel rod #d3	7929	1.33	0.02	10.8528
fuel rod #d4	3250	1.37	0.019	11.1682
fuel rod #d5	3695	1.51	0.019	12.3095
fuel rod #d6	7931	1.4	0.019	11.4128
fuel rod #d7	7926	1.36	0.019	11.0867
fuel rod #d8	3134	1.48	0.019	12.0650
fuel rod #d9	7930	1.37	0.019	11.1682
fuel rod #e1	4128	1.18	0.022	9.6477
fuel rod #e10	3017	1.25	0.021	10.21
fuel rod #e11	3863	1.28	0.021	10.4550
fuel rod #e12	3860	1.25	0.021	10.21
fuel rod #e13	3116	1.17	0.022	9.5659
fuel rod #e14	2445	1.15	0.022	9.4024
fuel rod #e15	5952	1.18	0.022	9.6477
fuel rod #e16	3022	1.14	0.022	9.3206
fuel rod #e17	3697	1.19	0.022	9.7294
fuel rod #e18	6587	1.16	0.022	9.4842
fuel rod #e19	5751	1.17	0.022	9.5659
fuel rod #e2	6843	1.11	0.022	9.0754
fuel rod #e20	5957	1.11	0.023	9.0842
fuel rod #e21	5699	0.96	0.022	7.8490
fuel rod #e22	5704	0.98	0.022	8.0125
fuel rod #e23	5705	0.93	0.022	7.6037



12 w/o in C2- all else is 8.5

125 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	1.12	0.022	9.1571
fuel rod #e3	6839	1.15	0.021	9.3932
fuel rod #e4	5761	1.19	0.021	9.7199
fuel rod #e5	5755	1.19	0.021	9.7199
fuel rod #e6	5754	1.27	0.021	10.3734
fuel rod #e7	6840	1.25	0.021	10.21
fuel rod #e8	3857	1.25	0.021	10.21
fuel rod #e9	5013	1.25	0.021	10.21
fuel rod #f1	5726	0.82	0.025	6.724
fuel rod #f10	5759	0.94	0.024	7.7005
fuel rod #f11	5748	0.91	0.024	7.4547
fuel rod #f12	5728	0.88	0.023	7.2019
fuel rod #f13	5735	0.93	0.024	7.6186
fuel rod #f14	5744	0.9	0.024	7.3728
fuel rod #f15	5737	0.88	0.024	7.2090
fuel rod #f16	5716	0.81	0.024	6.6355
fuel rod #f17	5730	0.84	0.024	6.8813
fuel rod #f18	5743	0.82	0.025	6.724
fuel rod #f19	5740	0.83	0.025	6.806
fuel rod #f2	5707	0.88	0.024	7.2090
fuel rod #f20	5706	0.84	0.024	6.8813
fuel rod #f21	5731	0.78	0.025	6.396
fuel rod #f22	5732	0.83	0.025	6.806
fuel rod #f23	5729	0.8	0.025	6.56
fuel rod #f24	5753	0.78	0.025	6.396
fuel rod #f25	5745	0.82	0.025	6.724
fuel rod #f26	5725	0.76	0.026	6.2381
fuel rod #f27	5747	0.79	0.025	6.478
fuel rod #f28	5727	0.79	0.025	6.478
fuel rod #f29	5741	0.77	0.025	6.314
fuel rod #f3	5717	0.88	0.025	7.216
fuel rod #f30	5756	0.83	0.025	6.806
fuel rod #f4	5719	0.87	0.024	7.1270
fuel rod #f5	5734	0.87	0.024	7.1270
fuel rod #f6	5760	0.85	0.024	6.9632
fuel rod #f7	5739	0.88	0.024	7.2090
fuel rod #f8	5708	0.94	0.024	7.7005
fuel rod #f9	5750	0.88	0.024	7.2090
fuel rod #g1	9472	0.61	0.029	5.0215
fuel rod #g10	5720	0.62	0.028	5.0989
fuel rod #g11	5721	0.6	0.028	4.9344
fuel rod #g12	9473	0.68	0.027	5.5869
fuel rod #g13	5736	0.66	0.027	5.4226
fuel rod #g14	5698	0.66	0.028	5.4278
fuel rod #g15	9534	0.69	0.027	5.6690
fuel rod #g16	5701	0.62	0.028	5.0989
fuel rod #g17	7878	0.67	0.027	5.5047
fuel rod #g18	5723	0.61	0.028	5.0166
fuel rod #g19	5682	0.59	0.028	4.8522
fuel rod #g2	5687	0.57	0.028	4.6877
fuel rod #g20	9302	0.65	0.028	5.3456

## GSTR REACTOR ANALYSIS

3

2/22/95

12 w/o in C2- all else is 8.5

125 elements

GRID DESCRIPTION	Serial No	Power factor	Error	Max power (kW)
fuel rod #g21	5681	0.6	0.028	4.9344
fuel rod #g22	5676	0.61	0.028	5.0166
fuel rod #g23	5689	0.57	0.029	4.6922
fuel rod #g24	5749	0.59	0.029	4.8569
fuel rod #g25	5758	0.55	0.029	4.5276
fuel rod #g26	5688	0.57	0.029	4.6922
fuel rod #g27	5679	0.53	0.029	4.3630
fuel rod #g28	5678	0.56	0.03	4.6144
fuel rod #g29	5684	0.54	0.029	4.4453
fuel rod #g3	5703	0.63	0.028	5.1811
fuel rod #g30	5700	0.55	0.03	4.532
fuel rod #g31	5686	0.55	0.03	4.532
fuel rod #g32	5690	0.56	0.029	4.6099
fuel rod #g33	5718	0.55	0.03	4.532
fuel rod #g34	5685	0.57	0.029	4.6922
fuel rod #g35	5695	0.54	0.029	4.4453
fuel rod #g36	5746	0.57	0.03	4.6968
fuel rod #g4	5683	0.56	0.029	4.6099
fuel rod #g5	5738	0.66	0.028	5.4278
fuel rod #g6	5715	0.61	0.028	5.0166
fuel rod #g7	5762	0.58	0.028	4.7699
fuel rod #g8	5722	0.58	0.029	4.7746
fuel rod #g9	5724	0.65	0.027	5.3404

## CASE #10

GSTR REACTOR ANALYSIS

1

2/22/95

Ten 12 w/o in B,C rings 100 elements

GRID DESCRIPTION	Serial No	Power factor	Error	Max power (kw)
fuel rod 12 w/o #b1	7832	2.09	0.01	21.1090
fuel rod 12 w/o #b2	7833	2.12	0.01	21.4120
fuel rod 12 w/o #b3	7864	2.15	0.01	21.7150
fuel rod 12 w/o #b4	7865	2.08	0.01	21.0080
fuel rod 12 w/o #b5	7866	2.1	0.01	21.2100
fuel rod 12 w/o #b6	7867	1.99	0.01	20.0990
fuel rod #c1	9531	1.26	0.011	12.7386
fuel rod #c11	9842	1.33	0.011	13.4463
fuel rod #c12	1238	1.83	0.01	18.4830
fuel rod #c2	1240	1.87	0.01	18.8870
fuel rod #c3	7932	1.34	0.011	13.5474
FFCR in #c4	10252	1.56	0.011	15.7716
fuel rod #c5	9532	1.34	0.01	13.5340
fuel rod 12 w/o #c6	7869	1.97	0.01	19.8970
fuel rod #c7	9533	1.33	0.01	13.4330
fuel rod #c8	1235	1.91	0.01	19.2910
fuel rod #c9	3007	1.39	0.01	14.0390
FFCR in #d1	5765	0.94	0.012	9.5128
FFCR in #d10	5980	1.39	0.012	14.0668
fuel rod #d11	7200	1.26	0.011	12.7386
fuel rod #d12	7927	1.2	0.011	12.1320
fuel rod #d13	5007	1.18	0.011	11.9298
fuel rod #d14	3321	1.25	0.011	12.6375
fuel rod #d15	7933	1.1	0.011	11.1210
fuel rod #d16	4096	1.15	0.011	11.6265
fuel rod #d17	5030	1.16	0.012	11.7392
fuel rod #d18	2374	1.15	0.011	11.6265
fuel rod #d2	7928	1.12	0.011	11.3232
fuel rod #d3	7929	1.14	0.011	11.5254
fuel rod #d4	3250	1.17	0.011	11.8287
fuel rod #d5	3695	1.3	0.011	13.1430
fuel rod #d6	7931	1.2	0.011	12.1320
fuel rod #d7	7926	1.21	0.011	12.2331
fuel rod #d8	3134	1.28	0.011	12.9408
fuel rod #d9	7930	1.22	0.011	12.3342
fuel rod #e1	4128	0.96	0.013	9.7248
fuel rod #e10	3017	1.01	0.012	10.2212
fuel rod #e11	3863	1.05	0.012	10.6260
fuel rod #e12	3860	1.05	0.012	10.6260
fuel rod #e13	3116	1.02	0.012	10.3224
fuel rod #e14	2445	1	0.012	10.1200
fuel rod #e15	5952	1.05	0.012	10.6260
fuel rod #e16	3022	1.01	0.012	10.2212
fuel rod #e17	3697	1.02	0.012	10.3224
fuel rod #e18	6587	1	0.012	10.1200
fuel rod #e19	5751	0.97	0.012	9.8164
fuel rod #e2	6843	0.84	0.013	8.5092
fuel rod #e20	5957	0.92	0.013	9.3196
fuel rod #e21	5699	0.79	0.013	8.0027
fuel rod #e22	5704	0.8	0.013	8.1040
fuel rod #e23	5705	0.81	0.013	8.2053



## GSTR REACTOR ANALYSIS

2

2/22/95

Ten 12 w/o in B<sub>7</sub>C rings 100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kw)
fuel rod #e24	3361	0.96	0.013	9.7248
fuel rod #e3	6839	0.93	0.013	9.4209
fuel rod #e4	5761	0.94	0.013	9.5222
fuel rod #e5	5755	0.94	0.013	9.5222
fuel rod #e6	5754	0.97	0.012	9.8164
fuel rod #e7	6840	1.05	0.012	10.6260
fuel rod #e8	3857	1.04	0.012	10.5248
fuel rod #e9	5013	1.05	0.012	10.6260
fuel rod #f1	5726	0.61	0.015	6.1915
fuel rod #f10	5759	0.77	0.014	7.8078
fuel rod #f11	5748	0.71	0.014	7.1994
fuel rod #f12	5728	0.74	0.014	7.5036
fuel rod #f13	5735	0.74	0.014	7.5036
fuel rod #f14	5744	0.74	0.014	7.5036
fuel rod #f15	5737	0.74	0.014	7.5036
fuel rod #f16	5716	0.7	0.014	7.0980
fuel rod #f17	5730	0.74	0.014	7.5036
fuel rod #f18	5743	0.7	0.014	7.0980
fuel rod #f19	5740	0.7	0.014	7.0980
fuel rod #f2	5707	0.66	0.015	6.6990
fuel rod #f20	5706	0.72	0.014	7.3008
fuel rod #f21	5731	0.63	0.015	6.3945
fuel rod #f22	5732	0.69	0.014	6.9966
fuel rod #f23	5729	0.68	0.015	6.9020
fuel rod #f24	5753	0.67	0.015	6.8005
fuel rod #f25	5745	0.65	0.015	6.5975
fuel rod #f26	5725	0.6	0.015	6.0900
fuel rod #f27	5747	0.64	0.015	6.4960
fuel rod #f28	5727	0.66	0.015	6.6990
fuel rod #f29	5741	0.66	0.015	6.6990
fuel rod #f3	5717	0.64	0.015	6.4960
fuel rod #f30	5756	0.66	0.015	6.6990
fuel rod #f4	5719	0.65	0.015	6.5975
fuel rod #f5	5734	0.68	0.014	6.8952
fuel rod #f6	5760	0.64	0.015	6.4960
fuel rod #f7	5739	0.68	0.014	6.8952
fuel rod #f8	5708	0.7	0.014	7.0980
fuel rod #f9	5750	0.72	0.014	7.3008
fuel rod #g1	9472	0.48	0.017	4.8816
fuel rod #g10	5720	0.47	0.017	4.7799
water #g11				0.0000
water #g12				0.0000
fuel rod #g13	5736	0.51	0.016	5.1816
water #g14				0.0000
water #g15				0.0000
fuel rod #g16	5701	0.5	0.016	5.0800
water #g17				0.0000
water #g18				0.0000
fuel rod #g19	5682	0.5	0.016	5.0800
water #g2				0.0000
water #g20				0.0000

## GSTR REACTOR ANALYSIS

3

2/22/95

Ten 12 w/o in B,C rings      100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kw)
water #g21				0.0000
fuel rod #g22	5876	0.51	0.017	5.1867
water #g23				0.0000
water #g24				0.0000
fuel rod #g25	5758	0.48	0.017	4.8816
water #g26				0.0000
water #g27				0.0000
fuel rod #g28	5678	0.44	0.017	4.4748
water #g29				0.0000
water #g3				0.0000
water #g30				0.0000
fuel rod #g31	5686	0.43	0.018	4.3774
water #g32				0.0000
water #g33				0.0000
water #g34				0.0000
water #g35				0.0000
water #g36				0.0000
fuel rod #g4	5683	0.44	0.018	4.4792
water #g5				0.0000
water #g6				0.0000
fuel rod #g7	5762	0.46	0.017	4.6782
water #g8				0.0000
water #g9				0.0000

## CASE #11

GSTR REACTOR ANALYSIS

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2/22/95

Eight 12 w/o in B,C rings

100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod 12 w/o #b1	7832	2.11	0.01	21.3110
fuel rod #b2	9304	1.73	0.01	17.4730
fuel rod 12 w/o #b3	7864	2.12	0.01	21.4120
fuel rod 12 w/o #b4	7865	2.15	0.01	21.7150
fuel rod #b5	3701	1.59	0.01	16.0590
fuel rod 12 w/o #b6	7867	2.08	0.01	20.8060
fuel rod #c1	9531	1.27	0.011	12.8397
fuel rod #c11	9842	1.33	0.011	13.4463
fuel rod #c12	1238	1.84	0.01	18.5840
fuel rod #c2	1240	1.92	0.01	19.3920
fuel rod #c3	7932	1.38	0.01	13.9380
FFCR in #c4	10252	1.58	0.011	15.9738
fuel rod #c5	9532	1.38	0.01	13.9380
fuel rod 12 w/o #c6	7869	1.98	0.01	19.9980
fuel rod #c7	9533	1.34	0.01	13.5340
fuel rod #c8	1235	1.9	0.01	19.1900
fuel rod #c9	3007	1.39	0.01	14.0390
FFCR in #d1	5765	0.96	0.012	9.7152
FFCR in #d10	5980	1.39	0.011	14.0529
fuel rod #d11	7200	1.25	0.011	12.6375
fuel rod #d12	7927	1.17	0.011	11.8287
fuel rod #d13	5007	1.16	0.011	11.7276
fuel rod #d14	3321	1.23	0.011	12.4353
fuel rod #d15	7933	1.11	0.011	11.2221
fuel rod #d16	4096	1.14	0.011	11.5254
fuel rod #d17	5030	1.14	0.012	11.5368
fuel rod #d18	2374	1.13	0.011	11.4243
fuel rod #d2	7928	1.18	0.011	11.9298
fuel rod #d3	7929	1.16	0.011	11.7276
fuel rod #d4	3250	1.19	0.011	12.0309
fuel rod #d5	3695	1.33	0.011	13.4463
fuel rod #d6	7931	1.21	0.011	12.2331
fuel rod #d7	7926	1.18	0.011	11.9298
fuel rod #d8	3134	1.23	0.011	12.4353
fuel rod #d9	7930	1.25	0.011	12.6375
fuel rod #e1	4128	0.96	0.013	9.7248
fuel rod #e10	3017	1.02	0.012	10.3224
fuel rod #e11	3863	1.1	0.012	11.1320
fuel rod #e12	3860	1.07	0.012	10.8284
fuel rod #e13	3116	1.03	0.012	10.4236
fuel rod #e14	2445	1	0.012	10.1200
fuel rod #e15	5952	1.02	0.012	10.3224
fuel rod #e16	3022	0.97	0.013	9.8261
fuel rod #e17	3697	0.99	0.012	10.0188
fuel rod #e18	6587	1.02	0.012	10.3224
fuel rod #e19	5751	0.99	0.012	10.0188
fuel rod #e2	6843	0.89	0.013	9.0157
fuel rod #e20	5957	0.92	0.013	9.3196
fuel rod #e21	5699	0.79	0.013	8.0027
fuel rod #e22	5704	0.82	0.013	8.3066
fuel rod #e23	5705	0.81	0.013	8.2053



Eight 12 w/o in B,C rings

100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
fuel rod #e24	3361	0.93	0.013	9.4209
fuel rod #e3	6839	0.97	0.012	9.8164
fuel rod #e4	5761	0.96	0.012	9.7152
fuel rod #e5	5755	1	0.012	10.1200
fuel rod #e6	5754	1.03	0.012	10.4236
fuel rod #e7	6840	1.07	0.012	10.8284
fuel rod #e8	3857	1.03	0.012	10.4236
fuel rod #e9	5013	1.03	0.012	10.4236
fuel rod #f1	5726	0.6	0.015	6.0900
fuel rod #f10	5759	0.74	0.014	7.5036
fuel rod #f11	5748	0.67	0.014	6.7938
fuel rod #f12	5728	0.75	0.014	7.6050
fuel rod #f13	5735	0.73	0.014	7.4022
fuel rod #f14	5744	0.74	0.014	7.5036
fuel rod #f15	5737	0.75	0.014	7.6050
fuel rod #f16	5716	0.7	0.014	7.0980
fuel rod #f17	5730	0.73	0.014	7.4022
fuel rod #f18	5743	0.7	0.014	7.0980
fuel rod #f19	5740	0.69	0.014	6.9966
fuel rod #f2	5707	0.7	0.014	7.0980
fuel rod #f20	5706	0.72	0.014	7.3008
fuel rod #f21	5731	0.63	0.015	6.3945
fuel rod #f22	5732	0.69	0.014	6.9966
fuel rod #f23	5729	0.68	0.015	6.9020
fuel rod #f24	5753	0.68	0.015	6.9020
fuel rod #f25	5745	0.68	0.014	6.8952
fuel rod #f26	5725	0.62	0.015	6.2930
fuel rod #f27	5747	0.65	0.015	6.5975
fuel rod #f28	5727	0.66	0.015	6.6990
fuel rod #f29	5741	0.65	0.015	6.5975
fuel rod #f3	5717	0.67	0.015	6.8005
fuel rod #f30	5756	0.65	0.015	6.5975
fuel rod #f4	5719	0.69	0.015	7.0035
fuel rod #f5	5734	0.71	0.014	7.1994
fuel rod #f6	5760	0.68	0.014	6.8952
fuel rod #f7	5739	0.73	0.014	7.4022
fuel rod #f8	5708	0.74	0.014	7.5036
fuel rod #f9	5750	0.73	0.014	7.4022
fuel rod #g1	9472	0.49	0.017	4.9833
fuel rod #g10	5720	0.5	0.016	5.0800
water #g11				0.0000
water #g12				0.0000
fuel rod #g13	5736	0.51	0.016	5.1816
water #g14				0.0000
water #g15				0.0000
fuel rod #g16	5701	0.51	0.016	5.1816
water #g17				0.0000
water #g18				0.0000
fuel rod #g19	5682	0.51	0.016	5.1816
water #g2				0.0000
water #g20				0.0000

Eight 12 w/o in B,C rings 100 elements

GRID DESCRIPTION	Serial No.	Power factor	Error	Max power (kW)
water #g21				0.0000
fuel rod #g22	5676	0.5	0.017	5.0850
water #g23				0.0000
water #g24				0.0000
fuel rod #g25	5758	0.49	0.017	4.9833
water #g26				0.0000
water #g27				0.0000
fuel rod #g28	5678	0.45	0.017	4.5765
water #g29				0.0000
water #g3				0.0000
water #g30				0.0000
fuel rod #g31	5686	0.44	0.017	4.4748
water #g32				0.0000
water #g33				0.0000
water #g34				0.0000
water #g35				0.0000
water #g36				0.0000
fuel rod #g4	5683	0.47	0.017	4.7799
water #g5				0.0000
water #g6				0.0000
fuel rod #g7	5762	0.48	0.017	4.8816
water #g8				0.0000
water #g9				0.0000