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NRC Docket No. 50-237

Subject: Core Operating Limits Report for Unit 2 Cycle 20 Revision 1

The purpose of this letter is to transmit Revision 1 of the Core Operating Limits Report (COLR) for Dresden Nuclear Power Station (DNPS) Unit 2 operating cycle 20 (D2C20) in accordance with Technical Specifications Section 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)."

In accordance with Generic Letter 88-16, these limits in the COLR are being modified to contain the cycle-specific parameter limits for DNPS Unit 2. The limits were determined using NRC-approved methodologies and are consistent with applicable limits of the plant safety analysis that are addressed in the Updated Final Safety Analysis Report.

Should you have any questions concerning this letter, please contact Mr. P. Salas at (815) 416-2800.

Respectfully,

David B Wozniak /s/ Danny Bost

Danny Bost
Site Vice President
Dresden Nuclear Power Station

Attachment: COLR for Dresden Unit 2 Cycle 20, Revision 1

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station

A001

# Core Operating Limits Report

# For

# Dresden Unit 2 Cycle 20

# Revision 1

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GE14-P10DNAB418-16GZ-100T-145-T6-2646
GE14-P10DNAB389-18GZ-100T-145-T6-2650
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# 1. Terms and Definitions

| | |
|---|---|
| APLHGR | Average planar linear heat generation rate |
| APRM | Average power range monitor |
| BOC | Beginning of cycle |
| DLO | Dual loop operation |
| ELLLA | Extended load line limit analysis |
| EOC | End of cycle |
| EOOS | Equipment out of service |
| EOR | End of rated conditions (i.e. cycle exposure at 100% power, 100% flow, all-rods-out) |
| FFTR | Final feedwater temperature reduction |
| FWHOOS | Feedwater heater out of service |
| GE14 | GE14C fuel |
| GNF | Global Nuclear Fuel |
| ICF | Increased core flow |
| LHGR | Linear heat generation rate |
| LHGRFAC(F) | Flow dependent LHGR multiplier |
| LHGRFAC(P) | Power dependent LHGR multiplier |
| LPRM | Local power range monitor |
| MAPFAC(F) | Flow dependent MAPLHGR multiplier |
| MAPFAC(P) | Power dependent MAPLHGR multiplier |
| MAPLHGR | Maximum average planar linear heat generation rate |
| MCPR | Minimum critical power ratio |
| MCPR(F) | Flow dependent MCPR |
| MCPR(P) | Power dependent MCPR |
| MELLLA | Maximum extended load line limit analysis |
| MSIV | Main steam isolation valve |
| OLMCPR | Operating limit minimum critical power ratio |
| OPRM | Oscillation power range monitor |
| PBDA | Period based detection algorithm |
| PLUOOS | Power load unbalance out of service |
| PROOS | Pressure regulator out of service |
| RBM | Rod block monitor |
| RWCU | Reactor water clean-up |
| RWE | Rod withdrawal error |
| RPTOOS | Recirculation pump trip out of service |
| SLMCPR | Safety limit minimum critical power ratio |
| SLO | Single loop operation |
| SRVOOS | Safety-relief valve out of service |
| TBPOOS | Turbine bypass system out of service |
| TCV | Turbine control valve |
| TCVOOS | Turbine control valve out of service |
| TIP | Traversing incore probe |
| TSV | Turbine stop valve |
| TSVOOS | Turbine stop valve out of service |

## 2. General Information

Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values.

Rated core flow is 98 Mlb/hr. Operation up to 108% rated flow is analyzed for this cycle. Licensed rated thermal power is 2957 MWth.

MCPR(P) and MCPR(F) values are independent of scram time.

LHGRFAC(P) and LHGRFAC(F) values are independent of scram speed.

For thermal limit monitoring above 100% rated power or 100% rated core flow, the 100% rated power and the 100% core flow values, respectively, can be used unless otherwise indicated in the applicable table.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

# 3. Average Planar Linear Heat Generation Rate

The MAPLHGR values for the most limiting lattice (excluding natural uranium) of each fuel type as a function of average planar exposure is given in Table 3-1. During single loop operation, these limits are multiplied by the SLO multiplier listed in Table 3-2.

**Table 3-1 MAPLHGR for bundle(s):**
**GE14-P10HNAB408-16GZ-100T-145-T6-2483**
**GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484**
**GE14-P10DNAB418-16GZ-100T-145-T6-2646**
**GE14-P10DNAB389-18GZ-100T-145-T6-2650**
**GE14-P10DNAB390-16GZ-100T-145-T6-2851**
**GE14-P10DNAB397-18GZ-100T-145-T6-2852**
(References 3 and 17)

| Avg. Planar Exposure (GWd/MT) | MAPLHGR (kW/ft) |
|---|---|
| 0.00 | 11.68 |
| 16.00 | 11.68 |
| 55.12 | 8.02 |
| 63.50 | 6.97 |
| 70.00 | 4.36 |

**Table 3-2 MAPLHGR SLO multiplier**
(Reference 3)

| Fuel Type | SLO Multiplier |
|---|---|
| GE14 | 0.77 |

# 4. Operating Limit Minimum Critical Power Ratio

## 4.1. Manual Flow Control MCPR Limits

The OLMCPR is determined for a given power and flow condition by evaluating the power-dependent MCPR and the flow-dependent MCPR and selecting the greater of the two.

### 4.1.1. Power-Dependent MCPR

For operation at less than 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power (MCPR(P)) is shown in Table 4-3. For operation at greater than 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power is determined by multiplying the applicable rated condition OLMCPR limit shown in Table 4-1 or 4-2 by the applicable MCPR multiplier K(P) given in Table 4-3. For operation at exactly 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power is the maximum of either of the two aforementioned methods evaluated at 38.5% of rated core thermal power.

### 4.1.2. Flow-Dependent MCPR

Tables 4-4 and 4-5 give the MCPR(F) limit as a function of the flow based on the applicable plant condition. The MCPR(F) limit determined from these tables is the flow dependent OLMCPR.

## 4.2. Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

## 4.3. Scram Time

Option A and Option B refer to scram speeds.

Option A scram speed is the Improved Technical Specification scram speed. The core average scram speed insertion time for 20% insertion must be less than or equal to the Technical Specification scram speed to utilize Option A MCPR limits. Reload analyses performed by (GNF) for Cycle 20 Option A MCPR limits utilized a 20% core average insertion time of 0.900 seconds (Reference 7).

To utilize the MCPR limits for the Option B scram speed, the core average scram insertion time for 20% insertion must be less than or equal to 0.694 seconds (Reference 7). If the core average scram insertion time does not meet the Option B criteria, but is within the Option A criteria, the appropriate MCPR value may be determined from a linear interpolation between the Option A and B limits with standard mathematical rounding to two decimal places. When performing a linear interpolation to determine MCPR limits, ensure that the time used for Option A is 0.900 seconds.

## 4.4. Recirculation Pump Motor Generator Settings

Cycle 20 was analyzed with a maximum core flow runout of 105%; therefore the recirculation pump motor generator scoop tube mechanical and electrical stops must be set to maintain core flow less than 105% (102.9 Mlb/hr) for all runout events (Reference 11 and 21). This value is bounded by the analyses of References 3 and 4.

**Table 4-1 MCPR Option A Based Operating Limits**
(References 3 and 4)

| EOOS Combination | Fuel Type | Cycle Exposure | |
|---|---|---|---|
| | | < EOR - 1707 MWd/MT | ≥ EOR - 1707 MWd/MT |
| BASE | GE14 | 1.56 | 1.67 |
| BASE SLO | GE14 | 1.57 | 1.68 |
| TBPOOS | GE14 | 1.74 | 1.76 |
| TBPOOS SLO | GE14 | 1.75 | 1.77 |
| TCV SLOW CLOSURE | GE14 | 1.60 | 1.67 |
| TCV SLOW CLOSURE SLO | GE14 | 1.61 | 1.68 |
| PLUOOS | GE14 | 1.64 | 1.67 |
| PLUOOS SLO | GE14 | 1.65 | 1.68 |
| TCV STUCK CLOSED | GE14 | 1.56 | 1.67 |
| TCV STUCK CLOSED SLO | GE14 | 1.57 | 1.68 |

**Table 4-2 MCPR Option B Based Operating Limits**
(References 3 and 4)

| EOOS Combination | Fuel Type | Cycle Exposure | |
|---|---|---|---|
| | | < EOR - 1707 MWd/MT | ≥ EOR - 1707 MWd/MT |
| BASE | GE14 | 1.45 | 1.50 |
| BASE SLO | GE14 | 1.46 | 1.51 |
| TBPOOS | GE14 | 1.57 | 1.59 |
| TBPOOS SLO | GE14 | 1.58 | 1.60 |
| TCV SLOW CLOSURE | GE14 | 1.45 | 1.50 |
| TCV SLOW CLOSURE SLO | GE14 | 1.46 | 1.51 |
| PLUOOS | GE14 | 1.47 | 1.50 |
| PLUOOS SLO | GE14 | 1.48 | 1.51 |
| TCV STUCK CLOSED | GE14 | 1.45 | 1.50 |
| TCV STUCK CLOSED SLO | GE14 | 1.46 | 1.51 |

**Table 4-3 MCPR(P) for GE Fuel**
(Reference 4)

| EOOS Combination | Core Flow (% Rated) | Core Thermal Power (% Rated) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 25 | 38.5 | 38.5 | 45 | 60 | 70 | 70 | 100 |
| | | Operating Limit MCPR | | | Operating Limit MCPR Multiplier, $K_P$ | | | | | |
| Base Case | ≤60 | 3.19 | 2.61 | 2.29 | 1.32 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 3.81 | 3.01 | 2.59 | | | | | | |
| Base Case SLO | ≤60 | 3.20 | 2.62 | 2.30 | 1.32 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 3.82 | 3.02 | 2.60 | | | | | | |
| TBPOOS | ≤60 | 5.60 | 3.81 | 2.84 | 1.37 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 6.85 | 4.66 | 3.48 | | | | | | |
| TBPOOS SLO | ≤60 | 5.61 | 3.82 | 2.85 | 1.37 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 6.86 | 4.67 | 3.49 | | | | | | |
| TCV Slow Closure | ≤60 | 3.19 | 2.61 | 2.29 | 1.64 | | 1.45 | 1.26 | 1.11 | 1.00 |
| | >60 | 3.81 | 3.01 | 2.59 | | | | | | |
| TCV Slow Closure SLO | ≤60 | 3.20 | 2.62 | 2.30 | 1.64 | | 1.45 | 1.26 | 1.11 | 1.00 |
| | >60 | 3.82 | 3.02 | 2.60 | | | | | | |
| PLUOOS | ≤60 | 3.19 | 2.61 | 2.29 | 1.64 | | 1.45 | 1.26 | 1.11 | 1.00 |
| | >60 | 3.81 | 3.01 | 2.59 | | | | | | |
| PLUOOS SLO | ≤60 | 3.20 | 2.62 | 2.30 | 1.64 | | 1.45 | 1.26 | 1.11 | 1.00 |
| | >60 | 3.82 | 3.02 | 2.60 | | | | | | |
| TCV Stuck Closed | ≤60 | 3.19 | 2.61 | 2.29 | 1.32 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 3.81 | 3.01 | 2.59 | | | | | | |
| TCV Stuck Closed SLO | ≤60 | 3.20 | 2.62 | 2.30 | 1.32 | 1.28 | 1.15 | | | 1.00 |
| | >60 | 3.82 | 3.02 | 2.60 | | | | | | |

**Table 4-4 MCPR(F) Limits for GE Fuel**
**All EOOS except TCV Stuck Closed**
**DLO or SLO Operation**
(Reference 9)

| Flow (% rated) | MCPR(F) Limit |
|---|---|
| 110.0 | 1.22 |
| 100.0 | 1.22 |
| 0.0 | 1.86 |

**Table 4-5 MCPR(F) Limits for GE Fuel**
**with TCV Stuck Closed**
**DLO or SLO Operation**
(Reference 9)

| Flow (% rated) | MCPR(F) Limit |
|---|---|
| 110.0 | 1.27 |
| 108.9 | 1.27 |
| 0.0 | 1.97 |

# 5. Linear Heat Generation Rate

The maximum Steady-State LHGR shall not exceed the limit of 13.4 KW/ft for the following fuel bundles (Reference 8).

**GE14-P10HNAB408-16GZ-100T-145-T6-2483**
**GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484**
**GE14-P10DNAB418-16GZ-100T-145-T6-2646**
**GE14-P10DNAB389-18GZ-100T-145-T6-2650**
**GE14-P10DNAB390-16GZ-100T-145-T6-2851**
**GE14-P10DNAB397-18GZ-100T-145-T6-2852**

The linear heat generation rate (LHGR) limit is the product of the exposure dependent LHGR limit from Tables 5-1 through 5-15 and the minimum of: the power dependent LHGR Factor, LHGRFAC(P), the flow dependent LHGR Factor, LHGRFAC(F), or the single loop operation (SLO) multiplication factor where applicable. The LHGRFAC(P) is determined from Table 5-16. The LHGRFAC(F) is determined from Table 5-17 or 5-18. The SLO multiplication factor can be found in Table 5-19.

**Table 5-1: LHGR Limit for GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484**
(Reference 5)

| **Lattices 5146, 5153, 5151, and 5156 Composite Limit kW/ft**<br><br>**5146: P10HNAL071-NOG-100T-T6-5146**<br>**5153: P10HNAL458-4G7.0/9G6.0-100T-T6-5153**<br>**5151: P10HNAL071-NOG-100T-V-T6-5151**<br>**5156: P10HNAL071-13GE-100T-V-T6-5156** | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0 | 13.4 |
| 16.0 | 13.4 |
| 63.5 | 8.0 |
| 70.0 | 5.0 |

**Table 5-2: LHGR Limit for: GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484, Lattice 5154**
(Reference 5)

| Lattice 5154 Composite Limit kW/ft<br>P10HNAL453-4G7.0/9G6.0-100T-E-T6-5154 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.40 |
| 15.1155 | 13.40 |
| 16.4055 | 13.3539 |
| 17.6796 | 13.1694 |
| 18.9383 | 13.0139 |
| 20.1833 | 12.8740 |
| 22.2507 | 12.5985 |
| 25.9250 | 12.1329 |
| 31.9779 | 11.3724 |
| 37.9426 | 10.6460 |
| 43.8088 | 9.9638 |
| 49.5729 | 9.3308 |
| 55.2416 | 8.7448 |
| 60.8333 | 8.1967 |
| 66.3754 | 6.6729 |
| 70.00 | 5.00 |

**Table 5-3: LHGR Limit for: GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484, Lattice 5155**
(Reference 5)

| Lattice 5155 Composite Limit kW/ft<br>P10HNAL453-4G7.0/9G6.0-100T-V-T6-5155 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.40 |
| 15.0231 | 13.40 |
| 16.3045 | 13.1997 |
| 17.5697 | 12.8942 |
| 18.8192 | 12.7533 |
| 19.6777 | 12.6793 |
| 22.1391 | 12.3631 |
| 25.7931 | 11.9027 |
| 31.8166 | 11.1486 |
| 37.7552 | 10.4255 |
| 43.5974 | 9.7428 |
| 49.3382 | 9.1060 |
| 54.9830 | 8.5136 |
| 60.5487 | 7.9572 |
| 66.0623 | 6.6464 |
| 70.00 | 4.8953 |

**Table 5-4: LHGR Limit for GE14-P10HNAB408-16GZ-100T-145-T6-2483**
(Reference 5)

| Lattices 5146, 5151, and 5152 Composite Limit kW/ft<br><br>5146: P10HNAL071-NOG-100T-T6-5146<br>5151: P10HNAL071-NOG-100T-V-T6-5151<br>5152: P10HNAL071-16GE-100T-V-T6-5152 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0 | 13.4 |
| 16.0 | 13.4 |
| 63.5 | 8.0 |
| 70.0 | 5.0 |

**Table 5-5: LHGR Limit for GE14-P10HNAB408-16GZ-100T-145-T6-2483, Lattice 5147**
(Reference 5)

| Lattice 5147 Composite Limit kW/ft<br><br>P10HNAL453-6G7.0/10G6.0-100T-T6-5147 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.40 |
| 15.1029 | 13.40 |
| 16.3915 | 13.3555 |
| 17.8387 | 13.1910 |
| 19.0967 | 13.0480 |
| 20.3425 | 12.9063 |
| 22.8024 | 12.6267 |
| 26.4384 | 12.0410 |
| 32.4022 | 11.2075 |
| 38.2538 | 10.4682 |
| 42.7774 | 9.9945 |
| 48.5585 | 9.4147 |
| 54.2876 | 8.8630 |
| 59.9673 | 8.4016 |
| 66.2463 | 6.7325 |
| 70.00 | 5.00 |

**Table 5-6: LHGR Limit for GE14-P10HNAB408-16GZ-100T-145-T6-2483, Lattice 5148**
(Reference 5)

| Lattice 5148 Composite Limit kW/ft<br>P10HNAL453-4G7.0/10G6.0-100T-T6-5148 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.40 |
| 15.1091 | 13.40 |
| 16.4011 | 13.3544 |
| 17.5754 | 13.2209 |
| 18.8411 | 13.0770 |
| 20.0941 | 12.9346 |
| 22.5665 | 12.6535 |
| 26.2178 | 12.2384 |
| 32.2045 | 11.4033 |
| 38.0774 | 10.5818 |
| 42.5631 | 9.9920 |
| 48.3669 | 9.3715 |
| 54.1169 | 8.7856 |
| 59.8150 | 8.2252 |
| 66.1438 | 6.7798 |
| 70.00 | 5.00 |

**Table 5-7: LHGR Limit for GE14-P10HNAB408-16GZ-100T-145-T6-2483, Lattice 5149**
(Reference 5)

| Lattice 5149 Composite Limit kW/ft<br>P10HNAL449-4G7.0/10G6.0-100T-E-T6-5149 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.3349 |
| 0.2995 | 13.3904 |
| 1.4867 | 13.40 |
| 2.9450 | 13.3896 |
| 4.3716 | 13.3335 |
| 5.7199 | 13.3052 |
| 7.0940 | 13.3190 |
| 8.3865 | 13.3625 |
| 9.7191 | 13.40 |
| 14.6797 | 13.40 |
| 15.9349 | 13.1347 |
| 17.1752 | 12.7239 |
| 18.4013 | 12.5086 |
| 19.6149 | 12.3467 |
| 22.0145 | 11.9721 |
| 25.5738 | 11.4887 |
| 31.4239 | 10.7236 |
| 36.1209 | 10.1987 |
| 41.9286 | 9.6294 |
| 47.6904 | 9.0846 |
| 53.4002 | 8.5554 |
| 59.0576 | 8.0299 |
| 64.6690 | 6.6179 |
| 68.5288 | 4.3146 |

**Table 5-8: LHGR Limit for GE14-P10HNAB408-16GZ-100T-145-T6-2483, Lattice 5150**
(Reference 5)

| Lattice 5150 Composite Limit kW/ft<br>P10HNAL449-4G7.0/10G6.0-100T-V-T6-5150 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.00 | 13.2336 |
| 0.3021 | 13.2853 |
| 1.4995 | 13.3007 |
| 2.9694 | 13.2651 |
| 4.3763 | 13.2094 |
| 5.7878 | 13.2221 |
| 7.1749 | 13.2302 |
| 8.5372 | 13.2351 |
| 9.7588 | 13.2502 |
| 10.9018 | 13.3145 |
| 12.2024 | 13.40 |
| 14.7592 | 13.40 |
| 16.0142 | 13.1015 |
| 17.2530 | 12.6893 |
| 18.4767 | 12.4795 |
| 19.6874 | 12.3406 |
| 22.0815 | 11.9671 |
| 25.6334 | 11.4807 |
| 31.4698 | 10.7081 |
| 36.2217 | 10.1947 |
| 42.0217 | 9.6164 |
| 47.7731 | 9.0632 |
| 53.4702 | 8.5267 |
| 59.1133 | 7.9955 |
| 64.7098 | 6.6069 |
| 68.6043 | 4.3130 |

**Table 5-9: LHGR Limit for GE14-P10DNAB418-16GZ-100T-145-T6-2646**
(Reference 14)

| Lattices 5963, 5970, 5971, 5974 and 5975 Composite Limit kW/ft<br><br>5963: P10DNAL071-NOG-100T-T6-5963<br>5970: P10DNAL465-16G7.0-100T-T6-5970<br>5971: P10DNAL465-13G7.0/3G6.0-100T-T6-5971<br>5974: P10DNAL071-NOG-100T-V-T6-5974<br>5975: P10DNAL071-16GE-100T-V-T6-5975 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0 | 13.4 |
| 16.0 | 13.4 |
| 63.5 | 8.0 |
| 70.0 | 5.0 |

**Table 5-10: LHGR Limit for: GE14-P10DNAB418-16GZ-100T-145-T6-2646, Lattice 5972**
(Reference 14)

| Lattice 5972 Composite Limit kW/ft<br>P10DNAL461-12G7.0/3G6.0-100T-E-T6-5972 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0000 | 13.4000 |
| 15.9515 | 13.4000 |
| 17.2857 | 13.2538 |
| 18.1089 | 13.1602 |
| 19.4140 | 13.0119 |
| 20.7050 | 12.8651 |
| 23.2463 | 12.5762 |
| 26.9800 | 12.1517 |
| 33.0780 | 11.4585 |
| 39.0585 | 10.7786 |
| 44.9195 | 10.0506 |
| 50.6634 | 9.3499 |
| 56.3043 | 8.7427 |
| 61.8691 | 8.1854 |
| 67.3941 | 6.2027 |
| 70.0000 | 5.0000 |

**Table 5-11: LHGR Limit for: GE14-P10DNAB418-16GZ-100T-145-T6-2646, Lattice 5973**
(Reference 14)

| Lattice 5973 Composite Limit kW/ft<br>P10DNAL461-12G7.0/3G6.0-100T-V-T6-5973 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0000 | 13.4000 |
| 14.6537 | 13.4000 |
| 16.0077 | 13.3991 |
| 17.3409 | 13.2476 |
| 18.1982 | 13.1501 |
| 19.5019 | 13.0019 |
| 20.7905 | 12.8554 |
| 23.3251 | 12.5672 |
| 27.0482 | 12.1440 |
| 33.1306 | 11.4525 |
| 39.0945 | 10.7607 |
| 44.9367 | 9.9688 |
| 50.6595 | 9.2608 |
| 56.2772 | 8.6476 |
| 61.8172 | 8.1267 |
| 67.3169 | 6.2384 |
| 70.0000 | 5.0000 |

**Table 5-12: LHGR Limit for GE14-P10DNAB389-18GZ-100T-145-T6-2650**
(Reference 14)

| Lattices 5963, 5994, 5995, 5998 and 5999 Composite Limit kW/ft<br><br>5963: P10DNAL071-NOG-100T-T6-5963<br>5994: P10DNAL430-17G8.0/1G3.0-100T-T6-5994<br>5995: P10DNAL431-9G8.0/8G6.0/1G3.0-100T-T6-5995<br>5998: P10DNAL071-NOG-100T-V-T6-5998<br>5999: P10DNAL071-18GE-100T-V-T6-5999 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0 | 13.4 |
| 16.0 | 13.4 |
| 63.5 | 8.0 |
| 70.0 | 5.0 |

**Table 5-13: LHGR Limit for GE14-P10DNAB389-18GZ-100T-145-T6-2650, Lattice 5996**
(Reference 14)

| Lattice 5996 Composite Limit kW/ft<br><br>P10DNAL430-7G8.0/8G6.0-100T-E-T6-5996 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0000 | 13.4000 |
| 14.8906 | 13.4000 |
| 16.2580 | 13.3707 |
| 17.6015 | 13.2179 |
| 18.9215 | 13.0679 |
| 19.4423 | 13.0087 |
| 20.7453 | 12.8605 |
| 23.3142 | 12.5685 |
| 27.0881 | 12.1395 |
| 33.2434 | 11.4389 |
| 39.2913 | 10.5936 |
| 45.2308 | 9.8060 |
| 51.0564 | 9.1014 |
| 56.7750 | 8.4943 |
| 61.9432 | 8.0319 |
| 67.9800 | 5.9323 |
| 70.0000 | 5.0000 |

**Table 5-14: LHGR Limit for GE14-P10DNAB389-18GZ-100T-145-T6-2650, Lattice 5997**
(Reference 14)

| Lattice 5997 Composite Limit kW/ft<br>P10DNAL430-7G8.0/8G6.0-100T-V-T6-5997 | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0000 | 13.4000 |
| 14.9485 | 13.4000 |
| 16.3156 | 13.3641 |
| 17.6577 | 13.1592 |
| 18.9752 | 12.9330 |
| 19.3601 | 12.9427 |
| 20.6567 | 12.8235 |
| 23.2117 | 12.5211 |
| 26.9637 | 12.0810 |
| 33.0874 | 11.3527 |
| 39.1088 | 10.5071 |
| 45.0238 | 9.6894 |
| 50.6192 | 8.9710 |
| 56.3453 | 8.3308 |
| 62.0012 | 7.7843 |
| 67.6125 | 6.1019 |
| 70.0000 | 5.0000 |

**Table 5-15: LHGR Limit for GE14-P10DNAB397-18GZ-100T-145-T6-2852 and GE14-P10DNAB390-16GZ-100T-145-T6-2851, all Lattices**
(Reference 16)

| Composite Limit (kW/ft), all Lattices | |
|---|---|
| **UO2 Pellet Burnup (GWd/MTU)** | **Composite Limit (kW/ft)** |
| 0.0 | 13.4 |
| 16.0 | 13.4 |
| 63.5 | 8.0 |
| 70.0 | 5.0 |

**Table 5-16 LHGRFAC(P) for GE Fuel**
(Reference 4)

| EOOS Combination | Core Flow (% Rated) | Core Thermal Power (% Rated) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 25 | 38.5 | 38.5 | 70 | 70 | 80 | 100 |
| | | LHGRFAC(P) Multiplier | | | | | | | |
| Base Case | All | 0.50 | 0.56 | 0.59 | 0.68 | | | 0.86 | 1.00 |
| Base Case SLO | All | 0.50 | 0.56 | 0.59 | 0.68 | | | 0.86 | 1.00 |
| TBPOOS | ≤60 | 0.22 | 0.39 | 0.48 | 0.54 | | | | 1.00 |
| | >60 | 0.33 | 0.39 | 0.42 | | | | | |
| TBPOOS SLO | ≤60 | 0.22 | 0.39 | 0.48 | 0.54 | | | | 1.00 |
| | >60 | 0.33 | 0.39 | 0.42 | | | | | |
| TCV Slow Closure | All | 0.54 | 0.54 | | 0.54 | 0.73 | 0.78 | | 1.00 |
| TCV Slow Closure SLO | All | 0.54 | 0.54 | | 0.54 | 0.73 | 0.78 | | 1.00 |
| PLUOOS | All | 0.54 | 0.54 | | 0.54 | 0.73 | 0.78 | | 1.00 |
| PLUOOS SLO | All | 0.54 | 0.54 | | 0.54 | 0.73 | 0.78 | | 1.00 |
| TCV Stuck Closed | All | 0.50 | 0.56 | 0.59 | 0.68 | | | 0.86 | 1.00 |
| TCV Stuck Closed SLO | All | 0.50 | 0.56 | 0.59 | 0.68 | | | 0.86 | 1.00 |

**Table 5-17 LHGRFAC(F) Multipliers for GE Fuel**
**All EOOS except TCV Stuck Closed**
**DLO or SLO Operation**
(Reference 4)

| Flow (% rated) | LHGRFAC(F) Multiplier |
|---|---|
| 110.0 | 1.00 |
| 100.0 | 1.00 |
| 80.0 | 1.00 |
| 50.0 | 0.77 |
| 40.0 | 0.64 |
| 30.0 | 0.55 |
| 0.0 | 0.28 |

**Table 5-18 LHGRFAC(F) Multipliers for GE Fuel**
**with TCV Stuck Closed**
**DLO or SLO Operation**
(Reference 4)

| Flow (% rated) | LHGRFAC(F) Multiplier |
|---|---|
| 110.0 | 1.00 |
| 100.0 | 1.00 |
| 98.3 | 1.00 |
| 80.0 | 0.86 |
| 50.0 | 0.63 |
| 40.0 | 0.50 |
| 30.0 | 0.41 |
| 0.0 | 0.14 |

**Table 5-19 LHGR SLO Multiplier**
(Reference 3)

| Fuel Type | SLO Multiplier |
|---|---|
| GE14 | 0.77 |

# 6. Rod Block Monitor

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below (Reference 6):

| ROD BLOCK MONITOR UPSCALE TRIP FUNCTION | ALLOWABLE VALUE |
|---|---|
| Two Recirculation Loop Operation | 0.65 $W_d$ + 55% |
| Single Recirculation Loop Operation | 0.65 $W_d$ + 51% |

The setpoint may be lower/higher and will still comply with the rod withdrawal error (RWE) analysis because RWE is analyzed unblocked.

$W_d$ – percent of recirculation loop drive flow required to produce a rated core flow of 98.0 Mlb/hr.

# 7. Stability Protection Setpoints

The OPRM PBDA Trip Settings (Reference 3):

| PBDA Trip Amplitude Setpoint (Sp) | Corresponding Maximum Confirmation Count Setpoint (Np) |
|---|---|
| ≤ 1.13 | ≤ 15 |

The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

The OPRM PBDA trip settings are applicable when the OPRM system is declared operable, and the associated Technical Specifications are implemented.

# 8. Modes of Operation

The allowed modes of operation with combinations of equipment out-of-service are as described below:

| Equipment Out of Service Options[1, 2, 3, 5, 7, 8, 9, 10] | Standard | ICF | MELLLA | Coastdown[4] |
|---|---|---|---|---|
| Base Case | Yes | Yes | Yes | Yes |
| Base Case SLO | Yes | No | Yes | Yes |
| TBPOOS | Yes | Yes | Yes | Yes |
| TBPOOS SLO | Yes | No | Yes | Yes |
| TCV Slow Closure | Yes | Yes | Yes | Yes |
| TCV Slow Closure SLO | Yes | No | Yes | Yes |
| PLUOOS | Yes | Yes | Yes | Yes |
| PLUOOS SLO | Yes | No | Yes | Yes |
| TCV Stuck Closed[6] | Yes | Yes | Yes | Yes |
| TCV Stuck Closed SLO[6] | Yes | No | Yes | Yes |

1. Each OOS Option may be combined with up to 18 TIP channels OOS (provided the requirements for utilizing SUBTIP methodology are met as clarified in Reference 18) with all TIPS available at startup from a refueling outage and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 2500 Effective Full Power Hours (EFPH) (2000 EFPH +25%).
2. A single MSIV may be taken OOS (shut) under any and all OOS Options, so long as core thermal power is maintained ≤75% of 2957 MWth (Reference 4).
3. Each EOOS option except TBPOOS requires the opening profile for the Turbine Bypass Valves provided in Reference 7 to be met. These conditions also support 1 Turbine Bypass Valve OOS (TBPOOS) if the assumed opening profile (Reference 7) for the remaining 8 Turbine Bypass Valves is met. If the opening profile is **not** met with 8 or 9 operating Turbine Bypass Valves, or if two Turbine Bypass Valves are OOS, utilize the TBPOOS condition.
4. Coastdown operation is defined as any cycle exposure beyond the full power, all rods out condition with plant power slowly lowering to a lesser value while core flow is held constant (Reference 10 Section 4.3.1.2.8). Up to a 15% overpower is analyzed per Reference 4.
5. For operation with a pressure regulator out-of-service (PROOS), the TCV Slow Closure limits should be applied. For operation with a PROOS and TCV Slow Closure, the TCV slow closure limits are applicable. For operation with a PROOS and PLUOOS, the PLUOOS limits are applicable (References 12 and 19).
6. Operation with one Turbine Stop Valve out-of-service (TSVOOS) is allowed as evaluated in Reference 15. Combination of one TSVOOS and TCV Stuck Closed is not allowed.
7. The cycle specific stability analysis may impose restrictions on the Power-to-flow map and/or restrict the applicable temperature for feedwater temperature reduction (FWTR).
8. Each EOOS option allows operation with up to a 120°F reduction in feedwater temperature (final feedwater temperature reduction or feedwater heaters OOS) throughout the cycle and is subject to the restrictions in Reference 13.
9. Asymmetric inlet enthalpy distribution produced by RWCU injection does not have a substantial impact on thermal margins; therefore no adjustments to the thermal margins are required (Reference 20).
10. For operation with a Pressure Regulator Out-Of-Service (PROOS) and TCV Stuck Closed, apply the more restrictive of the two limits, as applicable, for the TCV Stuck Closed flow dependent limits provided in Tables 4-5 and 5-18 and the TCV Slow Closure or PLUOOS power dependent limits provided in Tables 4-3 and 5-16 (Reference 4).

## 9. Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. NEDE-24011-P-A-14, June 2000 and the U.S. Supplement NEDE-24011-P-A-US, June 2000, "General Electric Standard Application for Reactor Fuel".

2. Commonwealth Edison Company Topical Report NFSR-0091, "Benchmark of CASMO/ MICROBURN BWR Nuclear Design Methods," Revision 0 and Supplements on Neutronic Licensing Analysis (Supplement 1) and La Salle County Unit 2 benchmarking (Supplement 2), December 1991, March 1992, and May 1992, respectively.

3. NEDO-32465-A, "BWR Owner's Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications", August 1996.

# 10. References


1. Exelon Generation Company, LLC, Docket No. 50-237, Dresden Nuclear Power Station, Unit 2 Renewed Facility Operating License, License No. DPR-19.
2. Letter from D. M. Crutchfield to All Power Reactor Licensees and Applicants, Generic Letter 88-16; Concerning the Removal of Cycle-Specific Parameter Limits from Tech Specs, October 3, 1988.
3. GNF Document, 0000-0035-6363-SRLR, Rev. 1, "Supplemental Reload Licensing Report for Dresden 2 Reload 19 Cycle 20," October 2005 (TODI NF0500248, Revision 0).
4. GE Document, GE-NE-J11-03912-00-01-R3, "Dresden 2 and 3 Quad Cities 1 and 2 Equipment Out-Of-Service and Legacy Fuel Transient Analysis," September 2005 (TODI NFM0100091 Sequence 03).
5. GNF Letter, FRL02EX-013, "Quad Cities Unit 1 Cycle 18 and Dresden Unit 3 Cycle 18 Pellet Based LHGR Limits", September 30, 2002.
6. GE DRF C51-00217-01, "Instrument Setpoint Calculation Nuclear Instrumentation, Rod Block Monitor, Commonwealth Edison Company, Dresden 2 & 3," December 15, 1999.
7. Dresden TODI Ops Ltr: 05-23, "OPL-3 Parameters for Dresden Unit 2 Cycle 20 Transient Analysis," July 15, 2005.
8. GE Design Basis Document, DB-0012.03, Revision 1, "Fuel-Rod Thermal-Mechanical Performance Limits for GE14C," May 2005.
9. NF Calculation, BNDG:02-001, Revision 0, "Determination of Generic $MCPR_F$ Limits," May 17, 2002.
10. GE Document, NEDE-24011-P-A-14, "General Electric Standard Application for Reactor Fuel," June 2000.
11. Nuclear Fuels TODI NF0500098, Revision 1, "Dresden 2 Cycle 20 FRED Form," July 5, 2005.
12. Nuclear Fuels Letter, NF-MW:02-0413, "Approval of GE Evaluation of Dresden and Quad Cities Pressure Regulator Out of Service Analysis," October 22, 2002.
13. Nuclear Fuels Letter, NF-MW:02-0081, "Approval of GE Evaluation of Dresden and Quad Cities Extended Final Feedwater Temperature Reduction," August 27, 2002.
14. GNF Letter, FRL-EXN-EE2-04-002, "Quad Cities Unit 2 Cycle 18 Fresh Fuel Peak Pellet LHGR Limits," January 16, 2004.
15. Nuclear Fuels Letter, NF-MW:03-069, "Dresden and Quad Cities Operation with One TSV OOS," July 28, 2003.
16. GNF Letter, MJM-EXN-EB2-05-108, "TSD B263: Dresden Unit 2 C20 LHGR Limits and R-Factors Data", October 7, 2005.
17. GNF Document 0000-0016-1235-SRLR, Rev. 0, "Supplemental Reload Licensing Report for Dresden Unit 2 Reload 18 Cycle 19", September 2003 (TODI NF0300089, Revision 0).
18. FANP Letter, NJC:04:031/FAB04-496, "Startup with TIP Equipment Out of Service," April 20, 2004 (EC 348897-00)
19. GE Document, GE-NE-0000-0040-2860-R0, "Dresden Units 2 and 3 and Quad Cities Units 1 and 2 Offrated Analyses Below the PLU Power Level", July 2005.
20. GE Document, GE-NE-0000-0036-4343-R0, "Evaluation of Dresden Asymmetric Reactor Water Cleanup Flow Injection", August 2005.
21. GE Document, GE-NE-0000-0044-3030-R0, "Evaluation of New Maximum Combined Flow Limiter Setting of 107% for Dresden 2", October 2005.