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The ARCADIA® Reactor Analysis System for PWRs Methodology Description and Benchmarking Results

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Nature of Changes

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Nomenclature

Acronym	Definition
AIC	Silver (Ag) Indium (I) cadmium (Cd) absorber
AMS	Aeroball Measurement System
APEX	Apollo2 Portable Exchange
APOLLO2 kernel	Multi-group deterministic neutron transport code developed by the Commissariat à l'Energie Atomique (CEA)
APOLLO2-A	AREVA Spectral Code System including APOLLO2 kernel
ARO	All Rods Out
BU	Burnup
B&W	Babcock & Wilcox
BOC	Beginning of Cycle
BWR	Boiling Water Reactor
CEA	Commissariat à l'Energie Atomique (French Atomic Energy Commission)
CP	Collision Probability
CPDF	Corner Point Discontinuity Factor
CSEWG	Cross-Section Evaluation Working Group
DSA	Diffusion Synthetic Acceleration
EFPD	Effective Full Power Days
ENDF	Evaluated Nuclear Data File
EOC	End of Cycle
EPDL	Evaluated Photon Data Library
EPR	Evolutionary Power Reactor
ERM1	Equivalent Reflector Model, 1D
ERU	Enriched Recycled Uranium
FA	Fuel Assembly
FF	Form Functions (2D normalized pin maps, code output)
FRM	Fuel Rod Module
HFP	Hot Full Power
HZP	Hot Zero Power
ICSBEP	International Criticality Safety Benchmark Evaluation project
IDT	Integro-Differential Transport (APOLLO2-A solver)

Acronym	Definition
IFBA	Integral Fuel Boron Absorber (uranium pellet with a thin coating of zirconium diboride ZrB_2)
IRSN	Institut de Radioprotection et de Surete Nucleaire (France)
JEFF	Joint Evaluated Fission and Fusion
LPF	Local Peaking Factor
LWR	Light Water Reactor
MCNP	Monte Carlo Neutron Photon developed by Los Alamos National Laboratory
MEDIAN	Measured Dependent Interpolation Algorithm using NEM (Nodal Expansion Method)
MLCMR	Multi-Level Coarse Mesh Rebalancing
MOC	Method Of Characteristics or Middle of Cycle
MOX	Mixed Oxide (usually U + Pu)
NEM	Nodal Expansion Methodology
NJOY	Nuclear Data Processing System
ppm	Parts per million
PSI	Paul Scherrer Institut (Switzerland)
PWR	Pressurized Water Reactor
Pyrex	Hollow B_2O_3-SiO_2 glass pellet
RMS	Root-Mean-Square
RPD	Radial Power Density
SCK-CEN	Studiecentrum Voor Kernenergie – Centre d'Etude de l'Energie Nucleaire (Belgium)
SGFF	Spacer Grid Form Function
SHEM	Santamarina Hfaiedh Energy Mesh (APOLLO2-A 281 energy group mesh)
SPND	Self-Powered Neutron Detector
TDC	Thermal Diffusion Coefficient
THM	Thermal-Hydraulic Module
UOX	Uranium Oxide
WABA	Wet Annular Burnable Absorber (hollow Al_2O_3-B_4C pellet with a central water region)
XS	Cross-Section

Equation Nomenclature

A	Cross-sectional area, (L^2)
c	Thermal conduction coefficient, ($H/T\theta L$)
C	Loss function for transverse cross-flow, (FT/ML)
D	Hydraulic diameter, (L)
f	Friction factor based on all-liquid flow, (dimensionless)
f_T	Turbulent momentum factor, (dimensionless)
g_c	Gravitational constant, (L/T^2)
H	Two-phase enthalpy, $Xh_g + (1-X)h_f$, (H/M)
h*	Enthalpy carried by diversion cross-flow, (H/M)
m	Flow rate, (M/T)
p	Pressure, (F/L^2)
v	Liquid specific volume, (L^3/M)
v'	Effective specific volume for momentum, $(1-X)^2/\rho_f(1-\alpha) + X^2/\rho_g\alpha$, ($L^3/M$)
w	Diversion cross-flow between adjacent subchannels, (M/TL)
w'	Turbulent (fluctuating) cross-flow between adjacent subchannels, (M/TL)
x	Distance, (L)
X	Quality, (dimensionless)
α	Void fraction, (dimensionless)
Θ	Orientation of channel with respect to vertical, (radians)
ρ	Two-phase density, $\rho_g\alpha + \rho_f(1-\alpha)$, ($M/L^3$)
ϕ	Two-phase friction multiplier, (dimensionless)
t	Time, (T)
u	Axial flow velocity, (L/T)
u''	Effective velocity for energy transport, (L/T)
u*	Axial velocity of cross-flow, (L/T)
q'	Linear surface heat flux, (H/TL)
T	Temperature, (θ)
K	Pressure loss coefficient, (dimensionless)
s	Gap width, (L)
l	Distance between subchannel centers, (L)

Subscripts

f,g	Saturated conditions for liquid and vapour, respectively
i,j	Subchannel identification number

ij	Subchannel connection i to j

Dimensions are denoted by:

l	length
T	time
M	Mass
θ	temperature
$F = ML/T^2$	force
$H = ML^2/T^2$	energy

1.0 INTRODUCTION

ARCADIA® is a code package that was developed for worldwide application and provides a converged code system within AREVA for neutronic and thermal-hydraulic core design and safety evaluation. This report presents a description of the ARCADIA® code system for the application to neutronic design analyses of pressurized water reactors. A separate Topical Report is generated for thermal-hydraulic design analyses, see Reference 1.1-1.

A flow chart of ARCADIA® is shown in Figure 1-1. The main components of the ARCADIA® system are the spectral/lattice code APOLLO2-A and the core simulator ARTEMIS. The state-of-the-art lattice physics code APOLLO2-A is an enhanced version relative to Reference 1.1-2 and is based on the APOLLO2 kernel developed by the Commissariat à l'Energie Atomique (CEA). It is adapted by AREVA for pressurized water reactor industrial applications. APOLLO2-A features several high level physics enhancements and requires fewer approximations compared to the previous generation of lattice physics codes.

The core simulator ARTEMIS is a 3D nodal multigroup reactor burnup code with pin power reconstruction for pressurized water reactors.

The main features of the ARCADIA® code system are:

A. Spectral code APOLLO2-A
   - Calculations performed in up to 281 energy groups with 26 fissile isotopes and 131 fission products explicitly treated,
   - Explicit treatment of resonance self-shielding in the energy range below 23 eV by an increased number of energy groups,
   - Calculation of the heterogeneous 2D multigroup flux and power density distribution using the Method of Characteristics (MOC),
   - Calculates gamma transport, and

- Master file for nuclear data, gamma production, and gamma transport based on the JEFF3.1.1 evaluation.

B. Reactor code ARTEMIS

- One cross-section library spanning the range from hot to cold conditions,
- Flexible definition of the nuclide chain (default 47 nuclides explicitly treated),
- Robust steady-state and transient advanced nodal solution techniques including highly efficient convergence acceleration methods, and
- Coupled Neutronics/Thermal-hydraulics/Thermal-mechanics.

Additional codes with central functionalities are applied for consistent input generation and for data processing. These auxiliary codes do not perform complex physical calculations but are executed in order to efficiently process the cross-section generation task. The main codes of this category are:

C. CLARUS

CLARUS is the tool for facilitating and generating standardized inputs for the generation of cross-section libraries with APOLLO2-A for use with ARTEMIS.

D. HERMES

HERMES has a twofold purpose. The first task is to evaluate the nuclear data on the APOLLO2-A APEX file (an output file from APOLLO2-A, see Figure 1-1) and to generate the final format cross-sections and heterogeneous form function files used with ARTEMIS. The second task within HERMES is the interpolation of this data with respect to the actual state parameters.

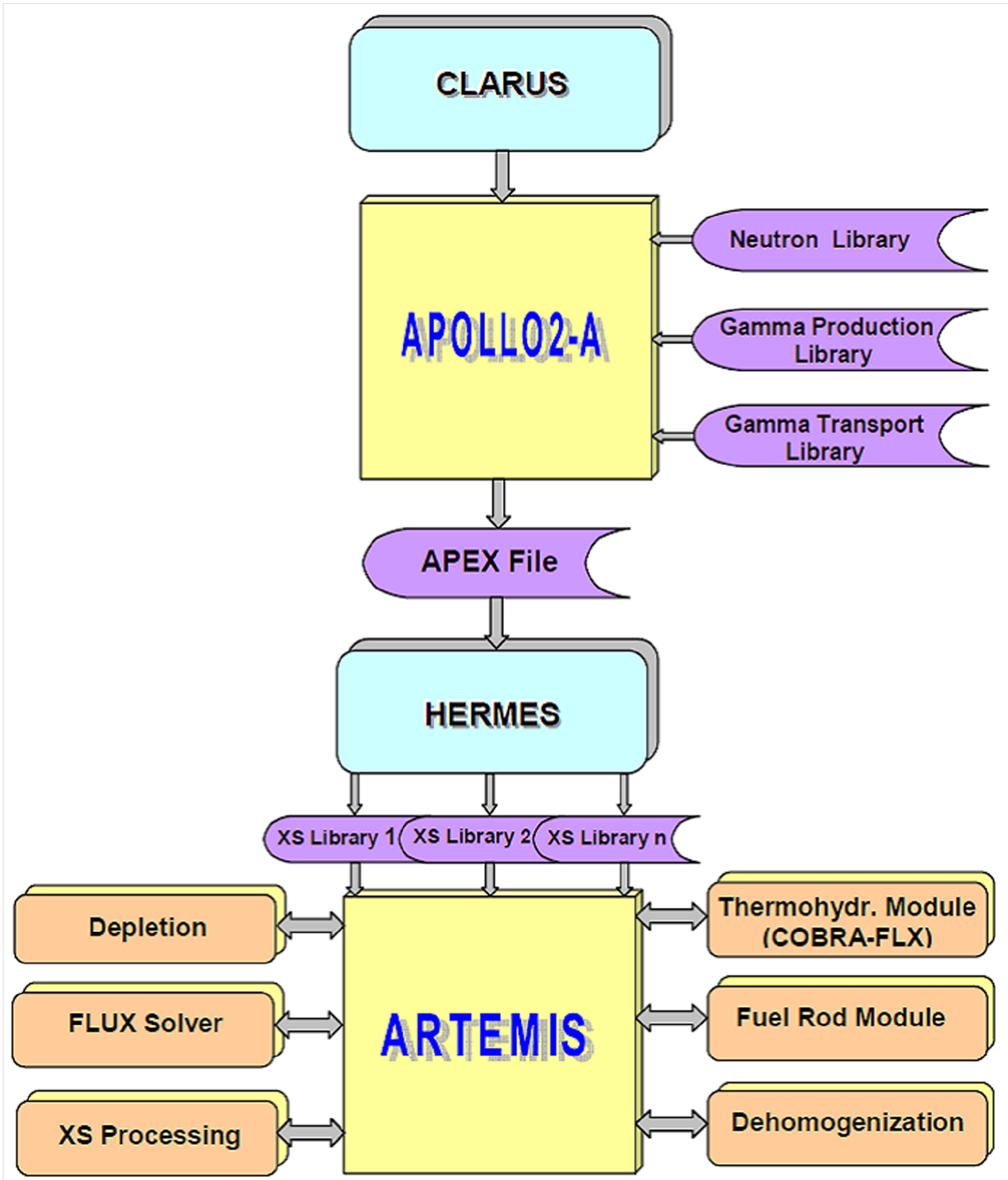
The following Chapters of this topical report describe the methodological details of ARCADIA® as well as the verification and validation of the code system.

1.1 *References*

1.1-1 ANP-10311, Rev. 0, COBRA-FLX: Core Thermal-Hydraulic Analysis Code

1.1-2 BAW-10288P-A, SCIENCE, December 2000

Figure 1-1: ARCADIA® Flowchart



2.0 APOLLO2-A METHODOLOGY

2.1 *Introduction*

APOLLO2-A is a deterministic neutron transport code designed for lattice physics calculations developed by AREVA for its industrial applications. APOLLO2-A solves the steady state 2D multi-group transport equation for neutrons and gammas on single fuel assemblies and on clusters of four fuel assemblies referred to as color-sets. AREVA has developed a new generic methodology capable of modeling PWR lattices (regardless of the fuel, absorber and geometry) with the most up-to-date numerical and physical models. This methodology is based upon a state-of-the-art MOC transport solver which can accurately handle irregular (unstructured) geometries using a 281-group neutron library based on the JEFF3.1.1 nuclear data evaluation. In addition, the APOLLO2-A validation is supported by a comprehensive set of experimental cases.

APOLLO2-A has two purposes:

- Generation of neutronic data libraries for 3D core simulators (e.g. cross-sections, form functions, discontinuity factors, etc. tabulated as a function of physical parameters such as burnup, moderator density and boron concentration);
- Stand-alone capabilities for studies and R&D applications (e.g., fine optimization of advanced fuel assembly design, validation, benchmarking, etc.).

APOLLO2-A is based on the APOLLO2 kernel developed by the Commissariat à l'Energie Atomique (CEA). The APOLLO2 kernel is a modular computer program that solves the Boltzmann transport equation in a multi-group scheme for different geometries (unstructured geometries, cell networks, or homogenized regions). It is adapted by AREVA for Pressurized Water Reactor (PWR) industrial applications.

2.2 *Methodology Overview*

The APOLLO2-A methodology is based on the most up-to-date numerical and physical models. The state-of-the art transport solver allows the analysis of unstructured geometries which is essential to obtain results with high precision. This is accomplished

by APOLLO2-A with the incorporation of its Method of Characteristics (MOC) solver. Since the assembly geometries of interest are complicated and require a few thousand meshes to be well-described, an improvement on the computational costs is obtained by reducing the number of energy groups dedicated to the MOC calculation. On the other hand, accurate calculations of self-shielded microscopic cross-sections are essential for the physical quality of results; however, the self-shielding model requires a fine energy description. As a result, macroscopic cross-sections need to be collapsed from the fine energy mesh used for self-shielding to a coarser energy mesh for the MOC solver with an appropriate flux weighting obtained through intermediate steps. This introduces the basic concept of a multi-level methodology involving several flux calculations and multiple flux reconstruction techniques to compute a 2D heterogeneous flux on a fine energy mesh and a fine spatial structure. The first two levels of flux calculations develop the so-called weighting flux; while the third level flux calculation yields the so-called master flux. The calculation flow implemented in APOLLO2-A is described below and represented in Figure 2-1. The main principle behind this multi-level methodology is an appropriate decoupling of the energy description from the spatial description of the flux.

The APOLLO2-A methodology is generic: it is used for PWR applications regardless of the fuel, absorber and geometry and needs no case-specific or global correction.

2.2.1 Cross-Section Preparation (Weighting Flux Computation)

Cross-section loading: The microscopic cross-sections are first read from the multi-group neutron library based on the JEFF3.1.1 nuclear data evaluation (see sub-section 2.3.1). The cross-sections are provided on the Santamarina Hfaiedh Energy Mesh (SHEM, 281 energy groups). This energy mesh avoids resonance self- and mutual-shielding treatment below 23 eV where complex resonance overlapping effects are observed, while keeping the number of groups and the computational burden at a reasonable level.

Self-shielding calculation: Microscopic cross-sections are then processed to take into account the self-shielding effect of the energy resonances above 23 eV for all the main isotopes with resonances. APOLLO2-A treats the self-shielding of the following materials: actinides (U, Pu, etc.), absorbers (Gd, Er, Dy, Ag, In, Cd, Hf, etc.), structural materials (Zr, Fe, etc.), and detector materials (Co, V, Rh, etc.). See sub-section 2.4 for further details. Within a cell, the spatial dependencies of cross-sections are taken into account using several rings (concentric layers). The same rings are used for the depletion calculation. The spatial dependencies between a cell and its surroundings are taken into account explicitly by a 2D flux calculation. This flux calculation uses the method of Collision Probabilities (CP) with an interface-current approximation (see sub-section 2.5.2) to provide accurate results with negligible computational burden.

First level flux calculation (281 energy groups): A flux is computed with the self-shielded microscopic cross-sections using the CP method (see sub-section 2.5.2) for several geometrical assembly components. Component geometry is a part of the full assembly geometry (water rods, water holes, etc.). At this step, one has a set of accurate fluxes with fine energy and fine cell-scale spatial description. This set of fluxes could be used as a weighting flux to provide the MOC solver with 35 group cross-sections but only with a short-range spatial coupling description. Therefore, the spatial coupling is first enhanced by another assembly-scale flux calculation.

Second level flux calculation (44 energy groups): This calculation models the assembly-scale spatial coupling phenomenon between cells. The assembly-scale flux is calculated with the Integro-Differential Transport (IDT) solver (see sub-section 2.5.3) on a 2D geometry with homogenized cells and 44 group macroscopic cross-sections. The cross-sections are obtained by weighting (for both energy and spatial variables) the microscopic cross-sections with the CP flux set (from the first level flux calculation).

Flux reconstruction: Both cell-scale and assembly-scale fluxes are combined using a reconstruction process to yield a 281 group flux with a cell-scale fine spatial description over the whole assembly geometry. See sub-section 2.6 for further details.

Leakage calculation: The fundamental buckling mode is used for computing a critical leakage rate on the assembly geometry. The reconstructed flux is then adjusted by a leakage correction, leading to a new flux. This flux is referred to as the weighting flux. See sub-section 2.7 for further details.

2.2.2 Master Flux Computation

Third level flux calculation (35 energy groups): The weighting flux is used to compute (through flux-volume weighting) the 35 energy group macroscopic cross-sections for each heterogeneous cell of the assembly. Compared to the cell-scale very fine spatial meshing used in the first level, the spatial description is still heterogeneous over every cell but a spatial homogenization is carried out to reduce the number of rings in the rods. The 35 group flux is then calculated by the MOC solver (see sub-section 2.5.4) on a very fine spatial grid (with thousands of meshes) representing the true heterogeneous geometry which is totally unstructured in the APOLLO2-MOC formulation. The so-called "unstructured geometry" is a geometry composed of calculation regions delimited by a combination of segments and arcs, as opposed to a Cartesian geometry based on a rectangular grid. To fully benefit from this high flexibility, an automated mesh generator is integrated in APOLLO2-A.

Flux reconstruction: On a 2D assembly geometry with very fine cell-scale spatial description, a final 281 group flux is reconstructed preserving the 35 energy group reaction rates obtained with the MOC flux. This flux combines the finest spectral and cell-scale spatial data from the first level with the best assembly-scale data available coming from the state-of-the-art MOC solver. See sub-section 2.6 for further details.

Leakage calculation: By making use of this flux, another 281 group critical leakage rate calculation is performed on the exact 2D assembly geometry with the fundamental buckling mode. The flux is then adjusted by a leakage correction, leading to a new flux. This flux is referred to as the master flux. The master flux is then used for outputs and for depletion calculation. See sub-section 2.7 for further details.

2.2.3 Depletion

The depletion is performed with the master flux. The depletion solver is based on the so-called ”predictor-corrector“ method with a quadratic extrapolation of the reaction rates and an automatic depletion step refinement which ensures accurate treatment of burnable absorbers. Each ring of each fuel pin is depleted separately with its own flux in order to reach the requested assembly burnup. APOLLO2-A offers the capability to perform zero power decay calculations (shutdown cooling). See sub-section 2.8 for further details.

2.2.4 Branch Calculation

The branch calculations, if requested, are performed after the depletion calculation to generate tabulated neutronic data for core simulator codes. A large combination of branch calculations can be performed to develop a sufficient database for nominal and transient core conditions. Before each branch calculation:

- The fuel media are retrieved from the depletion calculation and modified (temperature, density);
- New media are created;
- The geometries needed for the flux calculation are re-created.

Then a full flux calculation, including a self-shielding calculation, is performed for each branch calculation point.

2.2.5 Gamma Calculation

A gamma transport calculation is also performed with the MOC solver. A 94 group set of gamma sources is first computed from the reaction rates of all gamma-emitting

(prompt and delayed) reactions based on the fine neutron flux. Then, the gamma transport is computed in 18 energy groups. The resulting gamma flux is used for evaluating the gamma contribution to the detector response (see sub-section 2.10.2) as well as to improve the pin-by-pin power distribution (see sub-section 2.10.1).

2.2.6 Miscellaneous Models

A detailed energy deposition methodology (see sub-section 2.10.1) is implemented to compute pin-by-pin power distributions. In addition to local energy deposition in the pellet (by fission product kinetic energy and beta energy), the model separately accounts for neutron kinetic energy loss by slowing-down and gamma energy transport over the geometry.

Reflector data calculation may also be calculated. The APOLLO2-A reflector scheme is based on 1D slab geometry calculation. See sub-section 2.10.3 for further details.

As an option, APOLLO2-A can perform kinetics data calculations to provide the core simulators with the necessary data for transient analyses. See sub-section 2.10.4 for further details.

The color-set methodology of APOLLO2-A is very similar to the single fuel assembly methodology with one main difference: the 35 group cross-sections feeding the MOC flux solution over the entire color-set geometry are generated on each individual fuel assembly of the color-set. See Section 2.10.5 for further details.

Figure 2.2-1: APOLLO2-A Calculation flow

2.3 *Nuclear Data Libraries*

Two types of nuclear data libraries are used in APOLLO2-A: a multi-group neutron library and a multi-group gamma library. Actually, two different gamma libraries are available: one for the gamma production calculations and one for the gamma transport calculations.

2.3.1 Neutron Library

The neutron library is based on the JEFF3.1.1 nuclear data evaluation file. The processing chain of the neutron production library is based on the NJOY nuclear data processing system to convert the evaluated nuclear data in ENDF format into the form expected by the APOLLO2 kernel. This process was performed by CEA. The neutron library for APOLLO2-A is referred to as the CEA2005 library. The cross-sections are available on a 281 group energy mesh called SHEM energy mesh, designed by CEA and dedicated to Light Water Reactor (LWR) calculations. This mesh was developed through an individual isotope-by-isotope optimization analysis to explicitly describe the most important resonances of the main fission products and actinides. Therefore, the use of the SHEM energy structure avoids self-shielding calculation below 23eV and the use of the resonant mixture model. Only a Doppler broadening is performed below 23eV. The CEA2005 neutron library also provides the self-shielding data, the fission yields, the decay constants, the fission energies, the capture energies and the delayed neutron data.

2.3.2 Gamma Libraries

2.3.2.1 *Gamma Production Library*

Once the neutron transport calculation is performed, gamma sources that are induced by nuclear interactions can be computed. Other processes that do not involve nuclear interactions (e.g., electron deceleration and positron annihilation) cannot be modeled in APOLLO2-A calculations since other particles like electrons and positrons are not accounted for. Four main processes account for gamma production from nuclear interactions: fission, fission product decay, neutron capture, including (n,2n), and

inelastic scattering. The gammas produced from fission, radiative capture, and inelastic scattering are denoted as prompt gammas. The gammas produced from fission product decay are referred to as delayed gammas.

The gamma production library provides neutron to gamma multi-group transfer matrices (defined with a gamma emission spectrum and gamma multiplicity) for prompt gammas. Transfer matrices for delayed gammas are not well-known and therefore are not part of standard nuclear evaluations. A physical model, involving delayed gamma fractions, is used assuming that the delayed gamma spectrum is the same as the prompt gamma spectrum.

The gamma production library is based on the JEFF3.1.1 evaluation file. Yet, the evaluation does not provide gamma production data for all isotopes (e.g., Pu isotopes, Gd isotopes, many fission products, etc.). Therefore, the data from other nuclear evaluations (JEF2.2, ENDF/B-VI.4) are used to supply those missing in JEFF3.1.1. The processing chain of the gamma production library is based on the NJOY nuclear data processing system to convert evaluated nuclear data into the appropriate ENDF format. This process was performed by CEA. The library for APOLLO2-A is referred to as the CEA2005 gamma production library. It contains two energy meshes:

- One for the incident neutron: the SHEM 281 energy group structure;
- One for the emitted gamma: the CSEWG 94 energy group structure.

2.3.2.2 *Gamma Transport Library*

The gamma transport library is based exclusively on the Evaluated Photon Data Library, 1997 version (EPDL97). The processing chain of the gamma transport library is based on the NJOY nuclear data processing system to convert evaluated nuclear data in ENDF format into formats useful for the APOLLO2 kernel. This process was performed by CEA. The library for APOLLO2-A is referred to as the CEA2005 gamma transport library. The cross-sections are available in the CSEWG 94 energy group structure.

Gamma interactions depend on the incident gamma energy and the atomic number Z of the material composition. They do not depend on temperature. The interactions taken into account occur in the electronic field of an atom: absorption, inelastic scattering, elastic scattering, and pair production. The existing gamma interaction data libraries do not provide photonuclear data (i.e., for gamma interactions with nuclei). Thus, all nuclides of the same element share the same cross-sections. No self-shielding data are required since the cross-sections are not resonant.

2.4 *Self-shielding*

2.4.1 Introduction

The microscopic cross-sections contained in the evaluation file are virtually continuous in energy. In the resonance region (>23 eV), the cross-sections are highly variable for the heavy nuclides of interest in reactor problems. For the efficiency of calculations, the code solves the multi-group formulation of the transport equation using multi-group cross-sections. The derivation of the multi-group transport equation from the continuous energy form leads to the following definition of the multi-group cross-sections for every isotope x which is based on the conservation of a reference reaction rate:

$$\sigma_x^g(\vec{r}) = \frac{\int_g \sigma_x(u)\,\Phi(\vec{r},u)\,du}{\Delta u^g\ \Phi^g(\vec{r})} \qquad (2\text{-}1)$$

σ_x^g Microscopic cross-section for isotope x and for group g

Δu^g Lethargy width of group g

$\phi^g(\vec{r})$ Flux density within group g per lethargy unit:

$$\phi^g(\vec{r}) = \frac{1}{\Delta u^g}\int_g \Phi(\vec{r},u)\,du \qquad (2\text{-}2)$$

The essential feature of this equation is that it requires the knowledge of the continuous energy flux and the knowledge of the flux density within group g per lethargy unit which is, in fact, the solution of the problem to be solved. The multi-group cross-sections are

then computed from the continuous energy microscopic cross-sections contained in the evaluation file using a weighting flux. However, the weighting flux does not describe the fine energy structure of the real flux. The multi-group cross-sections do not account for the self-shielding phenomenon. Also, the spatial dependence of the multi-group cross-sections is not taken into account.

Thus, for a neutronic calculation scheme, and particularly for the spectral codes, the term "self-shielding" takes a slightly different meaning: it expresses the necessity to take the self-shielding into account by means of a dedicated "self-shielding model" for creating the multi-group library used by the spectral code for flux calculations.

By using a problem-independent library and by invoking equivalence theorems, the self-shielding module of APOLLO2-A has the capacity of elaborating a set of problem-dependent, multi-group, self-shielded cross-sections for resonant isotopes.

2.4.2 Overall Self-shielding Process

The self-shielding calculation is performed on each resonant isotope individually with the remaining isotopes being mixed and treated as one "mixing" isotope; however, the mixing isotope is comprised of the most up-to-date (self-shielded, if performed in a previous iteration for the isotope) cross-sections available. In other words, the cross-sections of the "mixing" isotope are "fixed" while the self-shielding model processes each individual resonant isotope separately. After a resonant isotope has been processed, the cross-section database (internal library) used to construct the "mixing" isotope is updated for the processed resonant isotope. Then, the process restarts with the next resonant isotope and the updated "mixing" isotope.

Validation studies have confirmed that for low-enriched (< 20%) LWR problems, the results are sufficiently converged after a single iteration, provided the ordering of the self-shielding calculations is appropriately chosen.

The self-shielding geometry is defined based on self-shielding areas. A self-shielding area is a set of flux calculation meshes containing the same resonant isotope with the

same temperature. For the most accurate self-shielding, one area per mesh can be used, but a sufficiently accurate and more economical self-shielding calculation can be performed by grouping the meshes. Thus the self-shielded multi-group cross-sections are calculated for the self-shielding areas, α.

2.4.3 Theory

The goal of the self-shielding model is to perform the calculation of the self-shielded multi-group cross-sections for every group, g, every isotope, x, and in every area, α. It is not possible to directly compute the reference reaction rate that has to be conserved since the real flux is unknown. To solve this problem, the basic APOLLO2-A self-shielding model is split into two main stages.

First, the APOLLO2-A self-shielding module computes the reference multi-group reaction rates using a process called homogenization (see sub-section 2.4.3.1).

Once the reference reaction rates are known, the APOLLO2-A self-shielding module determines the (unknown) self-shielded multi-group cross-sections using a multi-group equivalence (see sub-section 2.4.3.2).

2.4.3.1 *Homogenization*

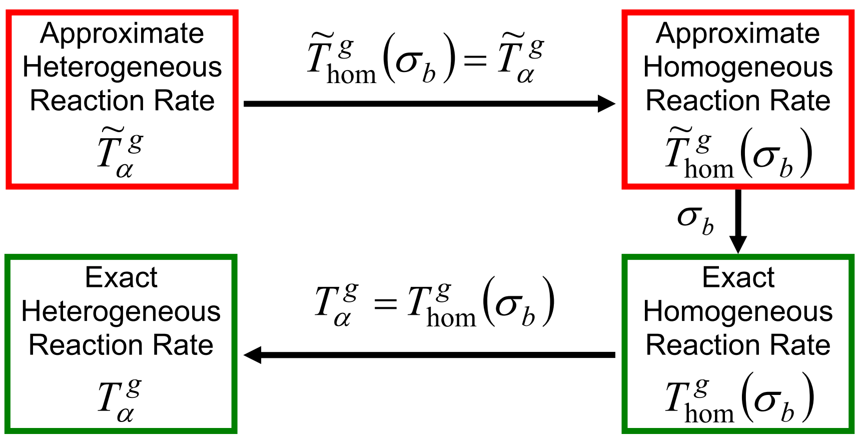
The goal of the homogenization stage is to obtain the exact multi-group reaction rates in every area of the self-shielding geometry. Figure 2.4-1 is presented as an illustration of the homogenization process.

The equation which models the neutron behavior in the resonance range is referred to as the slowing-down equation. This equation uses an operator that describes the slowing-down of the neutrons. Due to computational limits, it is not possible to solve the equation in the real problem-specific geometry, which is referred to as the heterogeneous problem, without using approximations for the slowing-down operator. Thus, APOLLO2-A solves it using approximations depending on the type of the

resonances. The solution of this equation yields approximate heterogeneous reaction rates for the heterogeneous problem.

There are two intermediate steps between the approximate heterogeneous reaction rates and the exact heterogeneous reaction rates.

Figure 2.4-1: Homogenization process



In these steps, simplified homogeneous problems, corresponding to the heterogeneous problems, are defined. The reaction rates of the homogeneous problems are assumed to be equivalent to the reaction rates of their corresponding heterogeneous problems provided that the correct equivalence parameter, the so-called dilution cross-section, σ_b, is used. The hypothesis is that, if equivalence can be established between two approximated computations, the same equivalence still holds between two exact computations.

The "exact" homogeneous problem is solved prior to the APOLLO2-A calculations by NJOY. The code solves the slowing-down equation without any approximations for the slowing-down operator. The "exact" homogeneous reaction rates are then stored within the neutron data library and are available for every resonant isotope. In addition, these reaction rates are tabulated as a function of the dilution cross-section. Determining the correct value of the dilution cross-section is paramount in finding the correct solution for the self-shielding calculation.

Determination of the correct value of the dilution cross-section is accomplished by computing the approximate homogeneous reaction rates for the homogeneous problem. The correct value is obtained through iterations between the reaction rates and the dilution cross-section. Once the reaction rates of the approximate homogeneous problem are equivalent to the reaction rates of the heterogeneous problem, the correct value of the dilution cross-section is reached.

The value of the dilution cross-section is assumed to be equivalent for both the approximate and exact problems (see Figure 2.4-1). Then, making use of the dilution cross-section, the "exact" homogeneous reaction rates are interpolated from the tabulated data in the neutron data library. Finally, the "exact" heterogeneous reaction rates are assumed to be equal to the "exact" homogeneous reaction rates. The self-shielded cross-sections are computed from the "exact" heterogeneous reaction rates in the next stage referred to as the multi-group equivalence (see sub-section 2.4.3.2).

2.4.3.2 *Multi-group Equivalence*

In the second stage, an equivalence procedure is applied to derive a set of multi-group self-shielded cross-sections that effectively preserves the reaction rates obtained in the first step. This equivalence procedure is done by iteratively solving a non-linear system composed of the same number of equations as the number of self-shielding areas:

$$\Delta u^g \ \sigma_\alpha^g \ \varphi_\alpha^g = T_\alpha^g \qquad (2\text{-}3)$$

α	Self-shielding area
T_α^g	Associated reaction rate obtained in the homogenization step per lethargy unit
$\sigma_\alpha^g \ \varphi_\alpha^g$	Self-shielded cross-section and flux
Δu^g	Lethargy width of group g

The flux depends on the distribution of the cross-sections in every self-shielding area. However, as explained in sub-section 2.4.2, the cross-sections of the "mixing" isotope

are “fixed”. Therefore the flux depends only on the distribution of the cross-sections for the resonant isotope being treated.

The system is solved iteratively. First, the flux is assumed known for every self-shielding area (a flat flux is used to initialize the process). Next, the microscopic cross-sections of the self-shielded isotope are computed, followed by the calculation of the macroscopic cross-sections for each mesh. Then, a new flux is calculated. This new flux is the basis for the next iteration. As described in sub-section 2.4.2, the global process is then repeated for the next resonant self-shielded isotope.

2.5 *Solving the Boltzmann Transport Equation*

As described in sub-section 2.2, the APOLLO2-A calculation scheme features several flux solvers in order to compute a 2D heterogeneous flux on the SHEM 281 energy group structure. Three different types of solvers are used to solve the Boltzmann transport equation either in its integral or integro-differential forms:

- The Collision Probability solver (CP) with the interface current approximation to manage a pseudo 2D calculation with a fine energy group structure on simplified geometries;
- The Integro-Differential Transport solver (IDT) to perform a 2D calculation with an intermediate energy group structure on a geometry with homogenized cells;
- The Method of Characteristics solver (MOC) to manage a 2D calculation with a coarse energy group structure on an exact heterogeneous geometry.

The main features of these three solvers are given hereafter.

It should be noted that two different transport solvers based on the method of characteristics for their spatial discretization are utilized within APOLLO2-A. However, only the APOLLO2-A MOC solver is attributed the name method of characteristics. For clarification, in sub-section 2.5, the term *MOC solver* will be used for the APOLLO2-A solver and the term *method of characteristics* will be used for the more general concept of spatial discretization.

2.5.1 The Boltzmann Transport Equation

The Boltzmann transport equation describes neutron-material interactions (e.g., elastic or inelastic scattering, capture, fission, etc.). APOLLO2-A solves the equation under the common general approximations used in lattice physics codes:

- Physical assumptions leading to a linear equation;
- Stationary approximation leading to a quasi-static equation;
- Eigenvalue formulation introducing an effective multiplication coefficient which divides the fission production term;
- Multi-group approximation defining a partition (or mesh) of the energy domain in a finite number of energy groups.

Under these approximations the stationary Boltzmann equation solved by APOLLO2-A can be written under two forms, the integro-differential form and the integral form for an energy group g on a space of phase $(\vec{r},\vec{\Omega})$, where $\vec{r} \in D$ and $\vec{\Omega}$ covers the whole sphere.

The integro-differential form is defined as:

- In X, space of phase $(\vec{r},\vec{\Omega})$:

$$\tilde{L}\Psi_g(\vec{r},\vec{\Omega}) = (\tilde{H}\Psi_g)(\vec{r},\vec{\Omega}) + \frac{1}{\lambda}(\tilde{F}\Psi_g)(\vec{r},\vec{\Omega}) + S_{ext,g}(\vec{r},\vec{\Omega}) \tag{2-4}$$

- At ∂D, external surface of the domain D:

$$\Psi_g(\vec{r},\vec{\Omega}) = \Psi_g^-(\vec{r},\vec{\Omega}) \tag{2-5}$$

$\Psi_g(\vec{r},\vec{\Omega})$ Unknown angular neutron flux in energy group g at position $\vec{r}$ for an angle $\vec{\Omega}$

$\Psi_g^-(\vec{r},\vec{\Omega})$ Angular flux in group g at position $\vec{r}$ for an angle $\vec{\Omega}$ on the external boundary of domain D.

λ Eigenvalue of the problem: k_{eff} is the greatest value (real and positive)

In multi-group theory, the advection $\tilde{L}$, scattering $\tilde{H}$ and fission source $\tilde{F}$ operator are so defined:

- The advection term represents the transport of a neutron in a direction $\vec{\Omega}$ being subject to a total collision which cross-section is $\Sigma_{Total}(\vec{r},E)$:

$$\tilde{L}\Psi_g(\vec{r},\vec{\Omega}) = \left[\vec{\Omega}.\nabla + \Sigma_g(\vec{r})\right]\Psi_g(\vec{r},\vec{\Omega})$$

- The scattering term describes how incoming neutrons colliding with a nucleus with an incoming direction $\vec{\Omega}'$ in energy group g' end up with a direction $\vec{\Omega}$ in energy group g. This term couples the different angles and different energies:

$$\tilde{H}\Psi_g(\vec{r},\vec{\Omega}) = \sum_{g'}\int_{\vec{\Omega}'}\Sigma^{g'\to g}(\vec{r},\vec{\Omega}'\to\vec{\Omega}) \times \Psi_{g'}(\vec{r},\vec{\Omega}')d\vec{\Omega}'$$

$\Sigma^{g'\to g}(\vec{r},\vec{\Omega}'\to\vec{\Omega})$	Scattering cross-section at position $\vec{r}$ from energy group g' to energy group g

- The fission source term described how incoming neutrons in energy group g' collide a nucleus x which fissions and produces $\nu_{x,g}$ neutrons isotropically with an energy spectrum $\chi_{x,g}$:

$$\tilde{F}\Psi_g(\vec{r},\vec{\Omega}) = \frac{1}{4\pi}\sum_x \nu_{x,g}\chi_{x,g}(\vec{r})\sum_{g'}\int_{\vec{\Omega}}\Sigma_{f,x,g'}(\vec{r}) \times \Psi_{g'}(\vec{r},\vec{\Omega})d\vec{\Omega}$$

$\nu_{x,g}(\vec{r})$	Multi-group number of neutrons emitted by fission in group g for isotope x at position $\vec{r}$
$\chi_{x,g}(\vec{r})$	Multi-group fission spectrum g for isotope x at position $\vec{r}$

The integral form is obtained from the integro-differential form by integration along characteristics, that is to say neutrons trajectories. Considering the characteristics starting from $\vec{r}_-$ on ∂X_- and pointing in direction $\vec{\Omega}$, equation (2-4) becomes:

- In X, space of phase $(\vec{r},\vec{\Omega})$:

$$\Psi_g(\vec{r},\vec{\Omega}) = e^{-\tau_-}\Psi_g^-(\vec{r}_-,\vec{\Omega}) + \int_0^{s_-} e^{-\tau} q_g(\vec{r}-s\vec{\Omega},\vec{\Omega})ds \quad (2\text{-}6)$$

$\vec{r}_- = \vec{r} - s_-\vec{\Omega}$ — Intersection (located on the incoming part of ∂D for the direction $\vec{\Omega}$ (i.e., where $\vec{n}.\vec{\Omega} < 0$, $\vec{n}$ being the outer pointing normal vector of the surface ∂D)) of the semi-trajectory $(\vec{r}, -\vec{\Omega})$ and surface ∂X_-

τ — Optical path between $\vec{r}$ and $\vec{r}'$

$$\tau = \tau(\vec{r}, \vec{r}') = \int_0^{|\vec{r}' - \vec{r}|} \Sigma\left(\vec{r} + (\frac{\vec{r}' - \vec{r}}{|\vec{r}' - \vec{r}|})x\right)dx$$

τ_- — Optical path between $\vec{r}$ and $\vec{r}_-$

$$\tau_- = \tau(\vec{r}, \vec{r}_-)$$

s_- — Distance between $\vec{r}$ and $\vec{r}_-$

$$s_- = |\vec{r} - \vec{r}_-|$$

$e^{-\tau}$ — Probability for a neutron to reach point $\vec{r}$ starting from point $\vec{r}'$ at distance $s = |\vec{r} - \vec{r}'|$ from $\vec{r}$ without undergoing any collisions

$q_g(\vec{r} - s\vec{\Omega}, \vec{\Omega}, E)$ — Neutron source at point $\vec{r}' = \vec{r} - s\vec{\Omega}$. It includes the fission neutrons plus the neutrons that reach, by collision, the group g.

Multi-group scattering cross-sections are stored as expansions of Legendre polynomials for the dependence on cosine angle.

$$\Sigma^{g' \to g}(\vec{r}, \vec{\Omega}' \to \vec{\Omega}) = \sum_{k \geq 0} P_k(\vec{\Omega}'.\vec{\Omega}) \times \Sigma_k^{g' \to g}(\vec{r}) \quad (2\text{-}7)$$

P_k — Legendre polynomial of order k

$\Sigma_k^{g' \to g}(\vec{r})$ — Multi-group scattering cross-section of order k at position $\vec{r}$:

$$\Sigma_k^{g' \to g}(\vec{r}) = \int_0^{4\pi} P_k(\mu) \times \Sigma^{g' \to g}(\vec{r}, \mu) \quad (2\text{-}8)$$

In APOLLO2-A, the development of scattering cross-sections is limited to the 1st order expansion of Legendre polynomials and the so-called P_0 transport correction, which takes into account the collision anisotropy of the 1st order, is applied.

To take into account the time variation of the flux, isotopic concentration depletion (see sub-section 2.8) is performed between each stationary calculation.

2.5.2 Collision Probability solver (CP)

The collision probability method within APOLLO2-A is mainly based on the interface current formulation using a flat flux approximation within each mesh. The integral form of the Boltzmann transport equation is solved for domain D, bounded by a surface, ∂D. With this interface current formulation, the domain is considered as a set of sub-domains D_i in mutual interaction by interface currents. A piecewise constant angular approximation is used to represent interface angular fluxes. Under these considerations the integral form of the Boltzmann transport equation can be derived under the following form for each sub-domain D_i of the D domain:

$$\begin{cases} V\Phi = PQ + P_{VS}J_- \\ J_+ = P_{SV}Q + P_{SS}J_- \\ J_- = J_0 + AJ_+ \end{cases} \tag{2-9}$$

Φ	Vector representing the flat scalar flux within each mesh i_k of sub-domain D_i
V	Diagonal matrix with the volume of each mesh i_k of the sub-domain D_i
Q	Vector which component k is the constant sources in region i_k in the sub-domain D_i defined as: $Q = \Sigma_{Scat}\Phi + S$
S	Multi-group source
J_+ and J_-	Entering (+) and exiting (-) components of the angular flux on the boundaries of the sub-domain D_i
J_0	Prescribed entering angular flux given as the boundary condition on the boundary of domain D
A	Coupling matrix between incoming and outgoing current on the

boundary of domain D only for sub-domains D_i having a common boundary with the domain D.

P, P_{SV}, P_{VS}, and P_{SS} are the collision probability matrices expressing respectively:

P	Probability for a neutron emitted in region i_k of the sub-domain D_i to have its first collision in region i_l of the sub-domain D_i.
P_{SV} and P_{VS}	Probability for a neutron to travel without collision from one surface of the sub-domain D_i to the interior of the domain D_i (P_{SV}) and inversely (P_{VS})
P_{SS}	Probability for a neutron to traverse the entire domain D_i (from one surface to another) without suffering a collision

$$P_{i_k i_l} = \frac{1}{4\pi} \int_{i_k \in D_i} d\vec{r} \int_{i_l \in D_i} d\vec{r}' \frac{e^{-\tau(\vec{r},\vec{r}')}}{|\vec{r}-\vec{r}'|^2}$$

$$P^{\rho}_{i_k \alpha} = \frac{S_\alpha}{4} \int_{i_k \in D_i} d\vec{r} \int_{\alpha} d^2\vec{r}_\alpha (\vec{\Omega}.\vec{n}_+) \frac{e^{-\tau(\vec{r},\vec{r}_\alpha)}}{|\vec{r}-\vec{r}_\alpha|^2} \Psi^{\rho}_{+,\alpha}(\vec{r}_\alpha,\vec{\Omega}) \; with \; \vec{\Omega}.\vec{n}_+ > 0 \tag{2-10}$$

$$P^{\rho\sigma}_{\alpha\beta} = \pi S_\alpha \int_{\alpha} d\vec{r}_\alpha \int_{\beta} d^2\vec{r}_\beta (\vec{\Omega}.\vec{n}^{\alpha}_{-})(\vec{\Omega}.\vec{n}^{\beta}_{+}) \frac{e^{-\tau(\vec{r}_\alpha,\vec{r}_\beta)}}{|\vec{r}_\alpha-\vec{r}_\beta|^2} \Psi^{\rho}_{+,\alpha}(\vec{r}_\alpha,\vec{\Omega}) \Psi^{\sigma}_{-,\beta}(\vec{r}_\beta,\vec{\Omega})$$

$\Psi^{\rho}_{+,\alpha}(\vec{r}_\alpha,\vec{\Omega})$	Basis function to represent the outgoing angular flux on a surface α of a sub-domain D_i
$\Psi^{\sigma}_{-,\beta}(\vec{r}_\beta,\vec{\Omega})$	Basis function to represent the incoming angular flux on a surface β of a sub-domain D_i
$\vec{n}^{\alpha}_{-}$	Perpendicular vector entering from surface α
$\vec{n}^{\beta}_{+}$	Perpendicular vector exiting surface β

Matrix P_{SV} is obtained from matrix P_{VS} by symmetry.

Several conservation and symmetry relations among the matrix elements are used to simplify the computation of these matrices.

Fluxes can be calculated by iterations on interface currents or by eliminating the latter and constructing a classical collision matrix for the fluxes.

The set of sub-domains D_i are coupled through the outgoing and incoming currents. When two sub-domains share a same surface, the incoming of a sub-domain is set to the outgoing current of the other sub-domain.

In practice, a sub-domain D_i corresponds to a fuel cell, an absorber cell or a guide tube cell with an explicit description of the pin and the cladding and the full domain corresponds to a lattice of pins. This formulation is used for all the pin lattice calculations.

Another approximation is used, based on the so-called “grouping strategy” on the multi-cell geometry. This approximation consists of reducing the number of variables to be calculated by assuming that the flux is the same on cells sharing a set of defined properties, based, for example, on the isotopic composition. Instead of computing the flux for all the regions, the flux is only computed for a few prototype cells called the "generating cells". The calculation geometry is defined as the repetition of generating cells that simulates the arrangement of rods in the assembly. The collision matrices are calculated for each generating cell coupled between one another by the outgoing and incoming current calculated on the boundary of each cell. In practice, it consists in resolving equation (2-9) only for a small number of sub-domains D_i corresponding to the "generating cells".

The CP solver with its interface current formulation and the grouping strategy is particularly well-adapted to compute the flux and the reaction rates in the self-shielding model.

2.5.3 Integro-Differential Transport Solver (IDT)

The IDT solver is the solver which computes the neutron flux on a 2D Cartesian geometry with 44 energy groups. In the frame of the APOLLO2-A calculation scheme,

the IDT solver is used to compute the flux on a lattice composed of homogenized media. The IDT solver is based on:

- The discrete ordinates approximation for the angular discretization;
- The method of characteristics in the context of a Cartesian geometry for the spatial discretization.

In the discrete ordinates approximation, the transport equation is solved for a finite set of directions $S_N = \{\vec{\Omega}_m, m = 1,\ldots,M\}$ together with a level-symmetric angular quadrature that allows writing the collision term in terms of the angular fluxes in the prescribed directions:

$$\widetilde{H}_S \Psi(\vec{r},\vec{\Omega}_N) = \sum_{k \le K} \Sigma^{g' \to g}_{Scat,k}(\vec{r}) \sum_{|l| \le k} A_{kl}(\vec{\Omega}_N) \phi^{kl}_g(\vec{r}) \tag{2-11}$$

K	Degree or order of scattering anisotropy
$\Sigma^{g' \to g}_{Scat,k}(\vec{r})$	Projection of $\Sigma^{g' \to g}_{Scat}(\vec{r})$ on the Legendre polynomial P_k
A_{kl}	Spherical harmonics

Applying the angular quadrature formula to the evaluation of $\phi^{kl}_g(\vec{r})$ gives:

$$\phi^{kl}_g(\vec{r}) = \frac{1}{4\pi} \int d\Omega . A_{kl}(\vec{\Omega}) \Psi(\vec{r},\vec{\Omega}) \approx \sum_m w_m A_{kl}(\vec{\Omega}_m) \Psi(\vec{r},\vec{\Omega}_m) \tag{2-12}$$

w_m	Weight determined by the level symmetric quadrature formula

This procedure yields a system of M equations for the angular fluxes in the selected angular directions coupled together with the collision term. From the equation (2-6) this set of equation can be written under the following form:

$$\Psi(\vec{r},\vec{\Omega}_N) = e^{-\Sigma l} \Psi_-(\vec{r}_-,\vec{\Omega}_N) + \frac{1}{4\pi} \int_0^l e^{-\Sigma(l-l')} q(\vec{r} - |l - l'| \vec{\Omega}_{N|XY}) dl' \tag{2-13}$$

$\vec{r} = (x, y)$	Position within a given cell
$\vec{r}_- = (x_-, y_-)$	Position located on a face of the given cell:

$$\vec{r}_- = (x_-, y_-) = \vec{r} - l\vec{\Omega}_{N|XY}$$

l Chord length between $\vec{r}$ and $\vec{r}_-$ defined as:

$$l = \frac{|\vec{r} - \vec{r}_-|}{|\vec{\Omega}_{N|XY}|}$$

$\vec{\Omega}_{N|XY}$ Projection of angle $\vec{\Omega}_m$ on the plan 2D plan XY where the calculation is performed.

q Source including the collision and fission terms

The equation (2-13) remains exact for each angle of the quadrature.

The method of characteristics is used to deal with the spatial discretization. This method is based on the balance equation which has to be solved for each cell. In the method of characteristics, the exact integral transport equation (2-13) is used to describe the transmission across the homogeneous mesh cell along a direction. The method of characteristics is applied on each cell independently and not on the full lattice.

The angular moments of the flux on the boundary of the cell are obtained with an exact propagation individually through each cell. The idea is to use the angular discretization described previously, to approximate the angular flux-volume and flux-surface.

For each $\vec{\Omega}_N \in S_N$, the flux $\Psi(\vec{r},\vec{\Omega}_N)$ is computed spatially. On each rectangular cell of size $\Delta_x \times \Delta_y$, the Method Of Characteristics and dimensionless variables $-1 \le x, y \le 1$ (to use the Legendre polynomial, see below) are used to compute $\Psi(\vec{r},\vec{\Omega}_N)$.

Legendre polynomial representations for the spatial dependence of the angular flux within the mesh cell interior and on its boundaries are used in the IDT solver. The cell interior angular flux for each discrete direction is:

$$\Psi(x, y) = \sum_{m,n\ge 0} (2m+1)(2n+1)\Psi_{mn} P_m(x) P_n(y) \tag{2-14}$$

P_m Legendre polynomial of order m

Ψ_{mn} Spatial moment in cell interior defined below.

A similar expansion is used for the angular source, for which the moments are noted, Q_{mn}. For example, the incoming (-) and exiting (+) angular fluxes on a surface perpendicular to the X axis are:

$$\Psi^{x_\pm}(y) = \Psi(\pm 1, y) = \sum_{n \geq 0} (2n+1) \Psi_n^{x_\pm} P_n(y) \tag{2-15}$$

$\Psi_n^{x_\pm}$ Spatial moment on the boundary perpendicular to the X axis defined below.

The expressions for fluxes on a surface perpendicular to the Y axis are analogous. The spatial moments in the cell interior and on the boundaries are respectively:

$$\Psi_{mn} = \frac{1}{4} \int_{-1}^{1} \Psi(x,y) P_m(x) P_n(y) dxdy$$
$$\Psi_n^{x_\pm} = \frac{1}{2} \int_{-1}^{1} \Psi^{x_\pm}(y) P_n(y) dy \tag{2-16}$$

APOLLO2-A uses a pure linear approximation, with only $(\Psi_{00}, \Psi_{01}, \Psi_{10})$ for the spatial moments in the cell and $(\Psi_0^{x_\pm}, \Psi_1^{x_\pm})$ on the boundary perpendicular to the X axis. The sources within a given cell are also represented as linear. Cross-sections are constant within the cell which is made of a unique homogeneous media.

Using these approximations of the surface and volume fluxes in equation (2-13) and projection this equation onto the Legendre polynomials leads to:

$$\Psi = CQ + I\Psi^{x_-, y_-}$$
$$\Psi^{x_+, y_+} = EQ + T\Psi^{x_-, y_-} \tag{2-17}$$

C Collision matrix

I Surface-to-volume matrix

E Escape matrix

T Transmission coefficients matrix

Vectors Ψ, Ψ^{x_+,y_+}, Ψ^{x_-,y_-} and Q contain the spatial approximation of the flux and the source in one discrete direction. The matrix elements of C, I, E and T representing respectively the collision, surface-to-volume, escape and transmission coefficients, depend on the optical size of the cell and the discrete direction cosines.

These matrices defined as:

$$
\begin{aligned}
T_{ym'}^{xn} &= \frac{2m'+1}{2}\int_S dy\ P_n(y)P_{m'}(x_-)e^{-\Sigma l} \\
E_{m'n'}^{xn} &= \frac{1}{2}\int_S dy\ P_n(y)F_{m'n'}(\vec{r}_+,\vec{r}_-) \\
I_{ym'}^{mn} &= \frac{2m'+1}{2}\int_V dxdy\ P_{mn}(x,y)P_{m'}(y_-)e^{-\Sigma l} \\
C_{m'n'}^{mn} &= \frac{1}{4}\int_V dxdy\ P_{mn}(x,y)F_{m'n'}(\vec{r},\vec{r}_0)
\end{aligned}
\tag{2-18}
$$

can be computed semi-analytically since the integration domain is a very simple: square or segment.

The IDT flux is computed cell by cell following the propagating direction $\vec{\Omega}_m$. The outgoing surface flux is used to set the incoming surface flux of the next cell. Once the 2D geometry has been covered, the IDT solver uses reflective boundary conditions on all external surfaces of the Cartesian geometry to update the incoming flux on the external surface, before computing the IDT flux for a new direction $\vec{\Omega}_{m+1}$. Finally the collision term is updated according to equation (2-11).

2.5.4 MOC Solver

The MOC solver is the solver of APOLLO2-A which computes the neutron flux on unstructured geometries (composed of calculation regions delimited by a succession of segments and circle arcs, as opposed to Cartesian geometries based on rectangular grids). With this solver, the heterogeneity of a lattice can be treated explicitly. Similar to the IDT solver, the MOC solver is based on:

- The discrete ordinates approximation for the angular discretization;
- The method of characteristics for the spatial discretization.

The flux, respectively the sources, is represented by a constant flux, respectively constant sources, within the cells and piecewise constant for the flux at the boundaries.

$$\Psi(\vec{r},\vec{\Omega}_N) \approx \sum_i \Psi^i(\vec{\Omega}_N)\theta^i(\vec{r}) \qquad (2\text{-}19)$$

$$q(\vec{r},\vec{\Omega}_N) \approx 4\pi \sum_i q^i(\vec{\Omega}_N)\theta^i(\vec{r}) \qquad (2\text{-}20)$$

$$\theta^i(\vec{r}) = \begin{cases} 1 \; if \; \vec{r} \in i \\ 0 \; if \; \vec{r} \notin i \end{cases}$$

To approximate the angular surface-flux:

- Parallel trajectories distant of $w_\perp(t,\vec{\Omega}_N)$ are tracked in the $\vec{\Omega}_{N|XY}$ direction on the MOC mesh;
- A cylinder is associated to each of these trajectories so that these trajectories define a partition of the domain.

Practically, a weight, $w_\perp(t,\vec{\Omega}_N)$, equal to the transverse section of the trajectory cylinder, is associated with each trajectory t. These so-defined trajectories are used to follow the particles and to compute the surface flux which is piecewise constant over the surface region i, taking into account the sources within each trajectories.

The key differences between the IDT and MOC solvers within APOLLO2-A are reviewed in Table 2.5-1.

Table 2.5-1: Key Differences Between IDT and MOC Solvers

Solver	MOC	IDT
Geometry	Unstructured	Cartesian
Tracking of characteristics	Along all the lattice	Within each cell
Angular quadrature	Product quadrature formula (the azimuthal angle are chosen to have periodic characteristics)	Level-symmetric angular quadrature
Spatial discretization	Constant flux over the volume and surface	Linear flux over the volume and surface

The angular discretization is based on the discrete ordinates angle (described in sub-section 2.5.3). However, contrary to the IDT solver, the MOC solver does not use the angular quadrature formula based on level-symmetric angular quadrature but a product quadrature formula. Azimuthal and polar angle are discretized independently. The angles are chosen according to the type of boundary condition used.

As for the IDT solver, the method of characteristics is used to deal with the spatial discretization. As in any differential method, neutron balance is locally preserved in every calculation region. The APOLLO2-A MOC solver assumes a constant volume-flux and constant sources within a region. The transmission equation estimates the change of the surface fluxes between the entering and the exiting surfaces of the region. Restricting the method to flat region sources sets a limit to the size of the regions that one may consider. Also, the distance between parallel trajectories has to be small enough to produce a good approximation for the surface angular fluxes.

Basically, exiting fluxes can be progressively computed for each cell along each trajectory, while current contributions can be temporarily stored and then used to yield cell-averaged fluxes.

As for the IDT solver, the transmission equation used to compute the exiting fluxes is (2-13).

With $\vec{r} = \vec{r}_+$ located on an outer boundary of region i along trajectory t and with the assumption of constant sources in region i, equation (2-13) becomes:

$$\Psi_+^i(t,\vec{\Omega}_N) = T^i(t,\vec{\Omega}_N)\Psi_-^i(t,\vec{\Omega}_N) + E^i(t,\vec{\Omega}_N)q^i(\vec{\Omega}_N) \qquad (2\text{-}21)$$

$T^i(t,\vec{\Omega}_N)$ Probability of transmission along trajectory t in region i

$$T^i(t,\vec{\Omega}_N) = e^{-\Sigma_i l_i(t,\vec{\Omega}_N)}$$

$E^i(t,\vec{\Omega}_N)$ Probability of escape along trajectory t in region i

$$E^i(t,\vec{\Omega}_N) = \frac{1 - T^i(t,\vec{\Omega}_N)}{\Sigma_i}$$

$l_i(t,\vec{\Omega}_N)$ Chord length of trajectory t in region i

$$l_i(t,\vec{\Omega}_N) = \frac{\left|\vec{r}_+ - \vec{r}_-\right|}{\left|\vec{\Omega}_{N|XY}\right|}$$

$\Psi_+^i(t,\vec{\Omega}_N)$, $\Psi_-^i(t,\vec{\Omega}_N)$ Fluxes on the outgoing (+) and incoming (-) boundary of cell i for trajectory t in direction $\vec{\Omega}_{N|XY}$

Equation (2-21) enables computation of the outgoing fluxes knowing the incoming fluxes of cell i for trajectory t in direction $\vec{\Omega}_{N|XY}$.

To express the volume-flux in region i, the integro-differential form of the Boltzmann equation (2-4) is integrated over the volume under the assumption of constant volume-flux and constant sources within a region:

$$J_+^i(\vec{\Omega}_N) - J_-^i(\vec{\Omega}_N) + V_i\Sigma_i\Psi^i(\vec{\Omega}_N) = V_i q^i(\vec{\Omega}_N) \qquad (2\text{-}22)$$

V_i Volume of region i

$J_\pm^i(\vec{\Omega}_N)$ Incoming (-) and outgoing (+) current in region i

$$J_\pm^i(\vec{\Omega}_N) = \int_{S_{\pm,i}(\vec{\Omega}_N)} dS\left|n.\vec{\Omega}_N\right|\Psi(\vec{r},\vec{\Omega}_N) = \int_{S_{\pm,i}(\vec{\Omega}_N)} dS_\perp \Psi_\pm^i(\vec{r}_\pm,\vec{\Omega}_N)$$

$\Psi^i(\vec{\Omega}_N)$ Volume-flux in region i

A quadrature is used to compute $J_{\pm}^{i}(\vec{\Omega}_N)$. The quadrature is obtained using the set of trajectories t tracked on the MOC mesh with the associated weight $w_{\perp}(t,\vec{\Omega}_N)$:

$$J_{\pm}^{i}(\vec{\Omega}_N) \approx \sum_{(t,\vec{\Omega}_N)\cap i} w_{\perp}(t,\vec{\Omega}_N)\Psi_{\pm}^{i}(t,\vec{\Omega}_N) \qquad (2\text{-}23)$$

When a region has been completely covered by the trajectories, the volume flux within this region can be computed using equation (2-22) and (2-23).

The tracking of characteristics is directly linked to the boundary conditions defined for the geometry. Unstructured meshes complicate the treatment of the boundary conditions. The solver tracks the characteristics to exactly treat the boundary conditions. The tracking is defined such that every region of the MOC solver is crossed by several trajectories. In practice, if a region smaller than the default tracking spacing is detected (e.g., self-powered neutron detector emitter region), the tracking spacing is reduced to ¼ of the smallest region length.

The two types of boundary conditions that can be applied within APOLLO2-A are referred as open or closed boundary conditions:

- An open boundary denotes a part of the boundary where an albedo-type or inhomogeneous, i.e., with a prescribed incoming angular flux, boundary condition is applied. In APOLLO2-A, it is possible to use a vacuum condition, i.e., a prescribed incoming flux equal to zero.
- As opposed to this concept, the term closed boundary indicates any part of the boundary of the domain where a reflective motion or periodic motion is applied. In this case, the trajectories are chosen to implicitly treat the boundary condition without any approximation.

In APOLLO2-A, domains are classified as open or closed, depending on whether they have an open boundary or not. The MOC solver can use reflective, periodic, or vacuum boundary conditions on all external surfaces of the unstructured geometry.

Then, as for the IDT solver, when all volume fluxes have been computed for all the angles of the quadrature, the collision term can be updated.

2.5.5 Generic Solution Process

For each of the three solvers, there are three levels of iteration in the calculation of the multi-group flux: external iteration, thermal iteration, and inner iteration. Separating the calculation in accordance with the iteration levels is useful, because it makes it possible to transform a non-linear energy group problem, such as the solution of the Boltzmann transport equation, into a series of mono-kinetic equations, which are solved via inner iterations and coupled to each other by external iterations.

Each external iteration uses a known source (the production of neutrons) to solve the equation group-by-group. Starting from the group with the highest energy, it is possible to move on to the groups with lower energies because the slowing down sources are known. This is true until reaching the thermal groups, where the energy up-scattering phenomenon can no longer be neglected. It is then necessary to perform iterations to reach convergence of the thermal fluxes. These iterations are referred to as thermal iterations.

The flux obtained at the end of each external iteration is used to calculate a new fission source that allows starting a new complete iteration until convergence is reached. For each external iteration, several inner iterations can be performed. In the inner iterations, an equation with known source terms is solved with the CP solver, the IDT solver, or the MOC solver. Different acceleration techniques, described in this sub-section, are used for each level of iterations to reduce the number of iterations. The external, thermal, and inner iterations are briefly described in the next three sub-sections.

2.5.5.1 *External Iteration*

In each of the external iterations, the multi-group flux is computed assuming that the fission sources are known. At the end of an external iteration, the multi-group flux is

then used to compute a new fission source to be used for the next external iteration. For the fast groups, the up-scattering is neglected. For the thermal groups, the up-scattering can no longer be neglected. Therefore, another level of iterations is set up for the thermal groups: the thermal iteration (see sub-section 2.5.5.2).

The external iteration process is converged when both the eigenvalue and the fission sources are converged i.e., they reach a given criteria for all energy groups and all calculation meshes. In order to obtain convergence with fewer iterations, different acceleration techniques are employed depending on the solver:

- For the CP solver, a residual minimization is carried out to accelerate the free iteration process. The solver alternates between free (i.e., without any acceleration process used) and accelerated iterations until convergence is reached.
- For the IDT solver, a Chebyshev acceleration is used. The Chebyshev acceleration makes a correction of the last fission term evaluation anticipating future changes. Practically, within APOLLO2-A, the first three external iterations are free and the acceleration is activated for the subsequent external iterations.
- For the MOC solver, a Diffusion Synthetic Acceleration (DSA) is used. For the external iteration, this method is extended to the multi-group approach.

2.5.5.2 *Thermal Iteration*

The multi-group transport equation takes into account the coupling among energy groups, due to up-scattering. In practice, neutron transfers among energy groups due to collisions only occur for groups whose energy is close to the thermal energy range. Therefore these iterations are performed only in the thermal domain, to ensure, on one hand, the convergence of the thermal fluxes, and, on the other hand, to avoid continuing unneeded iterations on the fast fluxes, because they are already converged.

In APOLLO2-A, supplementary iterations are performed only for the fluxes that need them. The flux is calculated using the up-scattering source from the previous thermal iteration. The thermal iteration convergence is achieved when the flux is converged i.e.,

it reaches a given criteria for all energy groups and all calculation meshes. To obtain convergence with fewer iterations, both a spectral rebalancing and a residual minimization acceleration technique are carried out for the three solvers. The spectral rebalancing consists of multiplying each component of the spatial flux by an energy group dependent parameter to ensure the conservation of the balance equation for each energy group.

2.5.5.3 *Inner Iteration*

The inner iterations are concerned with flux convergence over space. Actually, for the CP solver, there is no need of inner iterations since the fluxes are computed directly in one iteration. For the IDT and MOC solvers, the inner iterations are used.

The inner iteration convergence is achieved when the flux is converged (i.e. when it reaches a given criteria for all energy groups and all calculation meshes). In order to obtain convergence with fewer iterations, different acceleration techniques are carried out depending on the solver:

- For the CP solver, both a spatial rebalancing over the currents and residual minimization are performed. The spatial rebalancing over the currents consists of forcing the entering currents at inner iteration $i+1$ to respect the balance equation cell by cell or globally over the full geometry.
- For the IDT and MOC solvers, a specific Diffusion Synthetic Acceleration (DSA) is carried out. Practically, instead of using the transport operator, a numerically compatible diffusion operator is used.

2.5.6 Geometry, Boundary Condition and Symmetry

In APOLLO2-A, it is possible to define only certain types of space phases, boundary conditions, and symmetry.

2.5.6.1 *Geometry*

Lattices are defined on a finite 2D problem on the XY plane on which boundary conditions are applied. However, in the solver part, the angular flux is calculated with an angle defined in 3D.

2.5.6.2 *Boundary Conditions*

Three possible boundary conditions may be defined: reflection, periodic, and vacuum. They are classified in one of two ways:

- Closed boundary: it indicates a part of the boundary of the domain where a boundary condition of the geometrical motion type is applied and leads to an infinite lattice. This type applies to reflective motion and periodic motion.
- Open boundary: it indicates a part of the boundary where an albedo-type or inhomogeneous boundary condition (i.e., with a prescribed incoming angular flux) is applied. Vacuum condition stands for a prescribed incoming flux equal to zero.

Each solver (CP, IDT or MOC) takes into account the specified symmetry.

2.6 *Flux Reconstruction*

As described in sub-section 2.2, the direct computation of a 2D heterogeneous flux on a fine energy structure does not meet computation time and memory usage requirements for industrial applications. Therefore, a multi-level scheme is used. The principle is to uncouple the energy and the spatial dependence by using several flux calculations.

For instance, one can assume that the first flux calculation is performed with a fine energy group representation and a coarse spatial mesh whereas the second calculation is performed with a few group energy representation and a very fine spatial mesh. By making use of its reconstruction model, APOLLO2-A can then combine these two fluxes to obtain an accurate flux for both energy and spatial variables. The reconstruction model is also used to improve a flux by combining it with a flux computed by a more accurate solver. The scheme involves several simplified flux calculations and several flux reconstruction techniques.

Two flux reconstructions are performed in the scheme:

- Weighting flux reconstruction: the weighting flux is computed with the CP and IDT fluxes. It is then used to collapse the self-shielded cross-sections from the fine energy structure (SHEM, 281 groups) to the coarse energy structure (35 groups) for the MOC solver.
- Master flux reconstruction: the master flux is computed with the weighting flux and the MOC flux, while preserving the MOC reaction rates. It is used for depletion and output.

Without any correction, the weighting flux and the final reconstructed flux do not take into account leakage. Thus, to make the assembly critical, the so-called “leakage correction” (described in sub-section 2.7) is performed.

2.7 *Leakage Correction*

To make use of the real flux spectrum when collapsing the neutronic data for the core calculations, it is necessary to simulate the real leakage that leads to criticality and to correct the flux with this leakage. The technique used within APOLLO2-A consists of computing a leakage rate which is expressed as a product between a “critical buckling", B^2, and the leakage coefficient, D. The calculation of the leakage coefficient and the critical buckling are both based on the fundamental mode assumption.

The fundamental mode assumption considers an infinite homogeneous media at the criticality that allows deriving an equation simpler than the Boltzmann equation. In this case the flux can be expressed as the product of a function only depending on the angle and the energy group, and an exponential which carries out the spatial dependence and makes use of the critical buckling. This equation is easily solved to determine the D and the B^2 terms. The B^2 term is constant over space and energy, whereas D is constant over space but it is provided on the 281 group mesh.

The DB^2 product is then used to simulate the neutron leakage by adding this term to the absorption cross-sections. Since the calculation of DB^2 also depends on the cross-sections, the process that leads to the criticality is an iterative process. The leakage calculation is performed in four successive steps:

- Flux calculation in the heterogeneous assembly;
- Homogenization of the heterogeneous assembly to obtain the homogenized set of cross-sections;
- Computation of D and B^2 by solving the fundamental mode equation with the homogenized cross-sections;
- Use the DB^2 product to correct the absorption cross-sections.

Another iteration can then start with a new heterogeneous flux that is computed using the corrected cross-sections. However, in order to avoid several flux calculations, the process is limited to one iteration: a so-called “leakage correction” is applied to the flux

so that the spectral shape of the fundamental mode is preserved on the homogeneous assembly.

The fundamental mode calculation is carried out in the SHEM 281 group structure.

2.8 *Fuel Depletion*

The depletion is performed with the master flux normalized to the average mass power density specified for the assembly. Each ring of each fuel pin is depleted separately with its own flux in order to reach the requested assembly burnup. The depletion solver is based on the ”predictor-corrector“ method:

- The flux and the reaction rates are first extrapolated to the next time/burnup using a parabolic fluence approximation.
- Then, the extrapolated flux and rates are used to compute new ”predicted“ isotope concentrations.
- From these ”predicted“ isotopic concentrations, a full flux calculation (including self-shielding calculation) is completed to obtain “calculated” flux and reaction rates.
- These new ”calculated“ flux and reaction rates allow calculating new ”calculated“ isotopic concentrations.
- A convergence test is performed between the ”predicted“ and the ”calculated“ isotopic concentrations. If the convergence criterion is not reached, the length of the depletion step is divided by two, and the step is performed in two parts. If the convergence criterion is reached, the results of the last flux calculation are used for the next depletion step.

The standard APOLLO2-A depletion chain contains 26 fissile isotopes and 131 fission products. Materials which contain absorbers (e.g., PWR absorber control rods, IFBA, WABA, Pyrex, etc.) can also be depleted. Four depletion chains are available for burnable absorbers:

- A depletion chain for the most absorbing isotopes of AIC absorbing rods;
- A depletion chain for hafnium isotopes;

- A depletion chain for solid Boron used in B_4C, ZrB_2 layer of IFBA fuel cells, WABA, Pyrex, etc;
- A depletion chain for Gadolinium isotopes used in UO_2-Gd_2O_3 fuel and in non-fissile materials (e.g., gadolinium tubes Al_2O_3-Gd_2O_3).

Several detector emitters of pin detectors can be depleted making use of dedicated depletion chains (e.g., Cobalt or Rhodium in-core self-powered neutron detectors).

A xenon equilibrium model is also included in APOLLO2-A. The xenon equilibrium functionality estimates Xe135 and I135 equilibrium concentrations at the first state point of a depletion (zero burnup). The results of the initial depletion point are used to calculate the approximated equilibrium concentrations of Xe135 and I135. These concentrations are then set in the fuel media and flux calculation is performed again.

2.9 *Gamma Calculation*

Once neutron transport is performed, neutron-induced gamma sources are computed in 2D geometry with heterogeneous cells. Gamma production cross-sections are read from the gamma production library. The incident neutron energy mesh is 281 energy groups and the emitted gamma energy mesh is a 94 energy groups. Prompt gammas (from fission, radiative capture and inelastic scattering) and optional delayed gammas (from fission product decay) are taken into account.

The gamma transport cross-sections are read from the gamma transport library. Cross-sections are condensed from 94 to 18 energy groups with the internal flux of the library. The gamma transport is carried out with 18 energy groups on the explicit assembly geometry by the MOC solver.

2.10 *Miscellaneous Models*

2.10.1 Energy Deposition Model

Three components must be considered for deposited energy:

- Energy deposition from fission fragments and beta particles (local);

- Energy from neutron slowing down (non-local);
- Energy from gammas (non-local).

The APOLLO2-A neutron primary library provides, for each isotope, the energy released by fission and the energy released by capture. Those two terms combine both local and non-local energy contributions. To account for particle transport across the assembly, a dedicated energy deposition model is implemented. This model involves a neutron slowing down model and a simplified gamma source smearing.

The neutron slowing down model computes energy considering elastic and inelastic scattering, absorption and loss/gain by leakage. As for neutrons, deposited energy by gammas can be computed with an explicit gamma transport calculation with the MOC solver (as detailed in sub-section 2.9). For industrial applications, a simplified gamma source energy smearing across the assembly is performed assuming that gamma energy deposition is flat. The total gamma source energy of the whole assembly (fuel regions and also non fuel regions) is smeared homogeneously on fuel pins (since pin power distribution is provided on fuel pins only).

2.10.2 Pin Detector Model

The detector functionality can be used to describe neutron (or gamma) detectors in the central region of an instrumented guide tube (e.g., fission chambers, aero-balls, self-powered neutron detectors, etc.).

Pin detectors are located in the center of instrumented guide tubes or instrument tubes inside the lattice. The modeling involves the description of the geometrical data (detailed through a number of successive concentric material layers) and the physical characteristics of the detection mechanism (incident particles, reactions and isotopes involved, or, alternatively, a user defined multi-group sensitivity function). Any isotope can be used as long as the self-shielding is properly treated and no depletion is required. The current code version features the self-shielding and depletion of Co59 and Rh103.

2.10.3 Reflector Model

The purpose of the reflector model is to provide the necessary reflector data libraries for the use with core simulators (e.g., cross-sections and diffusion coefficient for the reflector nodes in the core).

APOLLO2-A models the fuel-reflector interface through a pseudo 1D-slab model that includes a fuel zone with the length of two fuel assemblies, plus a baffle/reflector zone where the baffle and the reflector are represented explicitly. The effective cross-sections used in the fuel region are obtained from a spatial homogenization of a single fuel assembly calculation in infinite medium using the fundamental mode. Reflective boundary conditions are assumed for the top and bottom surfaces of the geometry. Reflective boundary condition is used on the left side of the 1D-slab and vacuum boundary condition on the right side.

The data provided by this model are used as input to the ERM1 reflector cross-section generation procedure (see Chapter 7).

2.10.4 Kinetics Data

Derivation of the kinetics equation involves the introduction of the flux and the adjoint flux. Thus kinetics data are generated using weighting formulations involving these two fluxes. Kinetics data are then called “effective” kinetics data owing to the use of the adjoint flux since it is a measure of the “importance” or the worth of a neutron as a function of energy and position of the neutron. Use of the adjoint flux in the weighting formulation allows expressing the “effectiveness” of the neutrons.

Since the dependence on spatial variable for adjoint flux is weak for an assembly calculation, there is no need to compute a heterogeneous adjoint flux. The energy dependence of the adjoint flux provides the proper importance weighting for the emission spectra of the delayed neutrons.

Once neutron transport is performed, the 281 group self-shielded cross-sections are spatially flux-volume-averaged over the entire fuel assembly using the master flux (final 281 group reconstructed heterogeneous flux). No energy collapsing is performed in this step. The flux and adjoint flux are computed in 281 groups on the homogeneous assembly obtained in the previous step. APOLLO2-A then provides macroscopic assembly-averaged kinetics data. These data are spatially averaged over the assembly geometry and available for each of the individual fissile isotopes.

2.10.5 Color-Set Model

The color-set model performs neutron transport and burnup calculations on patterns of several fuel assemblies. Color-set calculations are used for stand-alone applications (e.g., power distribution at the boundaries of MOX and UOX assemblies, verification of the pin power reconstruction models in core simulators, benchmarking, etc.). The color-set functionality is not dedicated to the calculation of neutronic data libraries for core simulator codes.

A color-set geometry consists of several fuel assemblies placed on a regular squared grid with a constant pitch. Checkerboard fuel assembly arrangements may be defined depending on the internal symmetry of the color-set and the external boundary conditions. The boundaries of the calculation geometry are either defined along the external side of the fuel assemblies (no symmetry and diagonal symmetry) or defined along the middle of the fuel assemblies (quarter symmetry and octant symmetry). The external boundary conditions are either mirror (reflective) or periodic. Vacuum external boundary condition (total absorption) is also available.

Individual state parameters (fuel temperature, water properties, boron concentration, and insertion of absorber) are defined for each lattice. Color-sets are depleted with average power density and burnup state-points defined for the entire color-set.

The scheme for the color-set model is derived from the industrial scheme implemented for single fuel assemblies. Difficulty adapting the single-assembly scheme to color-sets

is mainly due to the cell pitch that can vary from one assembly to another. This implies that separate calculation geometries must be used for each assembly for dedicated cross-section preparation (self-shielding and weighting flux computation). Assemblies are then coupled together in the 2D heterogeneous MOC flux calculation performed on the whole color-set.

3.0 ARTEMIS NEUTRONIC METHODOLOGY

3.1 *Introduction*

This chapter provides a description of the neutronic methodology of the ARTEMIS code. Descriptions of the steady-state and transient flux solvers are provided in sub-sections 3.2 and 3.3 respectively. The coarse mesh rebalancing method for accelerating the solution is outlined in sub-section 3.4. The methods implemented for the evaluation of cross-sections and the depletion of nuclides are contained in sub-sections 3.5 and 3.6 respectively. The method used to reconstruct the pin values (dehomogenization) is presented in sub-section 3.7.

3.2 *The Steady-state 3D Multi-group Flux Solver FLUXS*

The ARTEMIS steady-state and transient flux solver modules FLUXS and FLUXT (References 3.10-1, 3.10-2) enable accurate three-dimensional (3D) multi-group steady-state and transient flux computations. These two modules have been derived from the flux solvers in CASCADE-3D's PANBOX transient simulation program (Reference 3.10-3) and PRISM fuel cycle simulation program (Reference 3.10-4). Relevant routines were adjusted to satisfy software requirements for the ARTEMIS code. The neutron physics equations are solved numerically in terms of a nodal expansion methodology (NEM). In full 3D space-kinetics mode, an implicit Euler method featuring frequency transformation is applied.

The starting point for the derivation of the NEM approach is the set of multi-group neutron diffusion equations in P_1 form (3-1). For steady-state conditions one obtains, for each energy group g:

$$\begin{aligned}\nabla \cdot \vec{j}_g(\vec{r}) + \left(\Sigma_{ag}(\vec{r}) + \sum_{g'=1}^{G} \Sigma_{g'g}(\vec{r}) \right) \varphi_g(\vec{r}) \\ = \sum_{g'=1}^{G} \left(\Sigma_{gg'}(\vec{r}) + \frac{1}{\lambda} \chi_g \nu \Sigma_{fg'}(\vec{r}) \right) \varphi_{g'}(\vec{r})\end{aligned} \qquad (3\text{-}1)$$

$$\vec{j}_g(\vec{r}) + D_g(\vec{r})\,\nabla\varphi_g(\vec{r}) = 0 \qquad (3\text{-}2)$$

The notation is fairly standard and is presented below:

φ_g and $\vec{j}_g$ are the flux and current, respectively, in each energy group g

χ_g is the fission spectrum in group g

$\nu\Sigma_{fg}$ is ν (neutrons per fission) times the macroscopic fission cross-section in group g

Σ_{ag} is the macroscopic absorption cross-section in group g

$\Sigma_{g'g}$ is the scattering cross-section for neutrons of initial energy g scattered into group g'

D_g is the diffusion constant in energy group g

The eigenvalue λ is equivalent to the neutronic effective multiplication factor k_{eff}, which for a critical, self-sustaining reactor is equal to 1. Equations (3–1) and (3–2) are to be solved subject to the boundary condition that $\varphi_g(\vec{r})$ be continuous everywhere and that the components perpendicular to internal surfaces of the current vector $\vec{j}_g(\vec{r})$ be continuous across these surfaces. Appropriate boundary conditions are imposed at the system boundaries. For reactor calculations, the incoming current vanishes at the exterior boundary. The ARTEMIS nodal methodology is characterized by the fact that spatial coupling is expressed in terms of interface currents (Reference 3.10-1). The exact nodal equations of this type can be obtained by integrating (3–1) over the Cartesian volume

$$V^m = a_x^m\, a_y^m\, a_z^m \qquad (3\text{-}3)$$

and (3–2) over the six surfaces of node m. The result is

$$\sum_{u=x,y,z}\frac{1}{a_u^m}\left[\left(j_{gul}^{-m}+j_{gur}^{+m}\right)-\left(j_{gul}^{+m}+j_{gur}^{-m}\right)\right] + \left[\Sigma_{ag}^m+\sum_{g'=1}^{G}\Sigma_{g'g}^m\right]\varphi_g^m = \sum_{g'=1}^{G}\left(\Sigma_{gg'}^m+\frac{1}{\lambda}\chi_g\nu\Sigma_{fg'}\right)\varphi_{g'}^m \qquad (3\text{-}4)$$

$$-D_g^m \frac{\partial \psi_{gu}^m}{a_u^m \partial u} = j_{gus}^{+m} - j_{gus}^{-m} \qquad (s = l, r;\ u = x, y, z) \tag{3-5}$$

where,

$$\phi_g^m = \frac{1}{V^m} \int_{V^m} \varphi_g(\vec{r})\, dV \tag{3-6}$$

$$\Sigma_g^m = \frac{1}{V^m\, \phi_g^m} \int_{V^m} \Sigma_g(\vec{r})\, \varphi_g(\vec{r})\, dV \tag{3-7}$$

$$\begin{aligned} \frac{1}{V^m} \int_{A_u^m} \vec{j}_{gur} \cdot \vec{n} dA &= \frac{1}{a_u^m}\left(j_{gur}^{+m} - j_{gur}^{-m}\right) \\ \frac{1}{V^m} \int_{A_u^m} \vec{j}_{gul} \cdot \vec{n} dA &= \frac{1}{a_u^m}\left(j_{gul}^{-m} - j_{gul}^{+m}\right) \quad (u = x, y, z) \end{aligned} \tag{3-8}$$

A_u^m denotes the transverse area of the outer nodal surface in Cartesian direction u of node m, (u = x, y, z); for example $A_x^m = a_y^m a_z^m$. The notations j_{gus}^{+m} and j_{gus}^{-m} indicate the average partial currents on the right (s = r) or left (s = l) surface of node m, respectively. This notation convention is illustrated graphically in Figure 3.2-1. The $\Psi_{gus}^m (s = l, r)$ are average surface fluxes defined by:

$$\psi_{gus}^m = \frac{1}{A_u^m} \int_0^{a_v^m} \int_0^{a_w^m} \varphi_g(\vec{r})\, dv\, dw \tag{3-9}$$

The flux-volume homogenized elements of the absorption, production and scattering cross-sections are determined by means of detailed heterogeneous calculations using the lattice code APOLLO2-A. Discontinuity factors f^m are also generated to provide continuity of the heterogeneous fluxes at the node surfaces for the homogenized solution. In the following equations, renormalized intranodal dimensionless coordinates u are adopted with $0 \le u \le 1$ covering all intranodal locations from the left node edge to the right node edge in Cartesian direction u. The transverse flux $\{\psi^m_{gu}(u)\}$ can be expressed as a fourth-order polynomial which approximates the solution of the

transverse-integrated (equivalent) 1D diffusion equations and reduces to the following equation when the discontinuity factors are directly included:

(3-10)

where the h_i are the NEM polynomials:

(3-11)

The first three coefficients of expansion (3–10) are determined by the nodal balance equations and continuity conditions. The higher–order coefficients can be determined by requiring that equation (3–10) is satisfied for the weighted residual form of the equivalent 1D diffusion equation:

$$\begin{aligned}&-\frac{\partial}{\partial u} D_g^m \frac{\partial}{\partial u} \psi_{gu}^m + \left[\Sigma_{agu}^m + \sum_{g'=1}^{G} \Sigma_{g'gu}^m\right] \psi_{gu}^m \\ &= \sum_{g'=1}^{G} \Sigma_{gg'u}^m \psi_{g'u}^m + \frac{1}{\lambda} \sum_{g'=1}^{G} \chi_g \nu \Sigma_{fg'u}^m \psi_{g'u}^m - D_g^m L_{gu}^m\end{aligned} \quad (3\text{-}12)$$

(see also equation 3-15). Equation (3–12) is obtained by a formal integration process. The index u for the cross-sections indicates a possible spatial dependency:

$$\Sigma_{gu}^m(u)\psi_{gu}^m(u) = \frac{1}{A_u^m} \int_0^{a_v^m} \int_0^{a_w^m} \Sigma_g^m(\vec{r}) \varphi_g(\vec{r}) dv\, dw \quad (3\text{-}13)$$

If Σ_{gu}^m is constant inside the node, no assumption about the flux shape is made. In case of heterogeneous nodes (example: burnup gradient), a polynomial approximation of the

flux shape and a second order variation in each direction of the cross-section dependence can be used in equation (3–13).

The term $D_g^m \, L_{gu}^m$ denotes the transverse leakage:

$$D_g^m \, L_{gu}^m = -\frac{1}{A_u^m} \int_0^{a_v^m} \int_0^{a_w^m} \left(\frac{\partial}{\partial v} D_g \frac{\partial}{\partial v} + \frac{\partial}{\partial w} D_g \frac{\partial}{\partial w} \right) \varphi_g(\vec{r}) \, dv \, dw \qquad (3\text{-}14)$$

[ ]

The third and fourth-order coefficients in the equation (3-10) are subsequently obtained by solving the weighted residual scheme.

[ ] (3-15)

As weight functions, the following set of functions is typically used for reasons of computational accuracy and efficiency:

$$\begin{aligned} w_1 &= h_1(u) \\ w_2 &= h_2(u) \end{aligned} \qquad (3\text{-}16)$$

Using the diffusion theory equation $\psi_{gus} = 2\left(j_{gus}^{+m} + j_{gus}^{-m}\right)$ and inserting the expansion (3–10) into Fick's law (3–5), the final form of the nodal interface current equations is given by:

$$\begin{aligned} j_{gul}^{-m} &= C_{0gul}^m \, \phi_g^m + C_{1gul}^m \, j_{gul}^{+m} + C_{2gul}^m \, j_{gur}^{-m} - C_{3gul}^m \, a_{3gu}^m + C_{4gul}^m \, a_{4gu}^m \\ j_{gul}^{+m} &= C_{0gur}^m \, \phi_g^m + C_{2gur}^m \, j_{gul}^{+m} + C_{1gur}^m \, j_{gur}^{-m} + C_{3gur}^m \, a_{3gu}^m + C_{4gur}^m \, a_{4gu}^m \end{aligned} \qquad (3\text{-}17)$$

where,

[

(3-18)

(3-19)

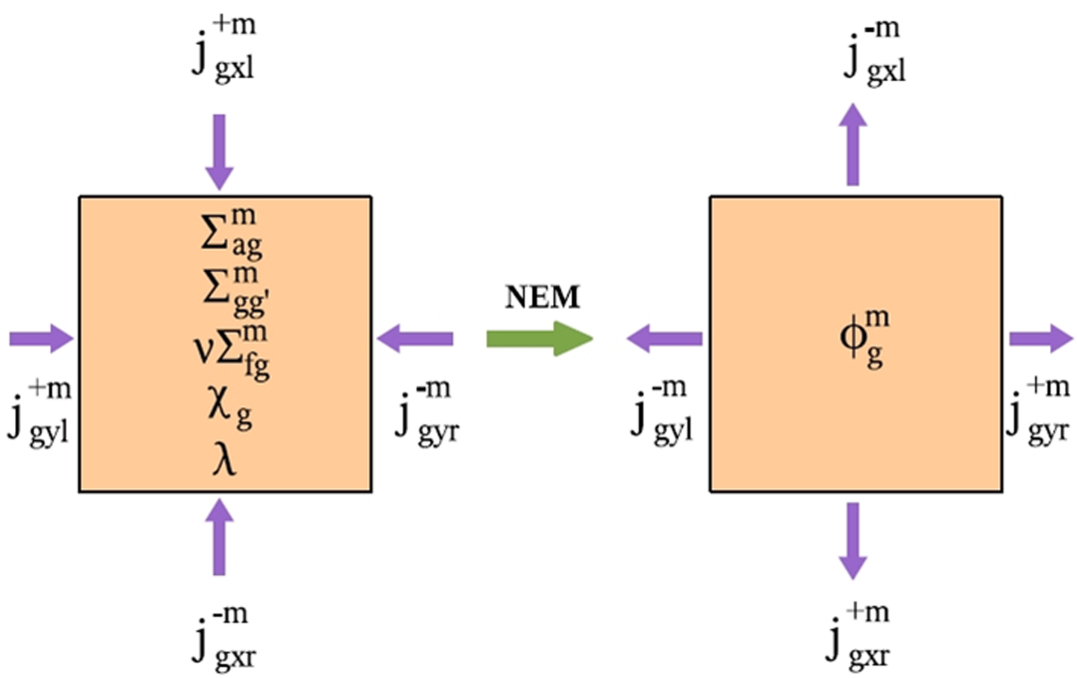
]

The resulting equations are solved for each node as an inhomogeneous boundary value problem. [

]

Figure 3.2-1 displays the NEM relationship between nodal cross-sections, in-currents, fluxes and out-currents. The first step in the solution process is to determine expansion coefficients in equation (3–10) from the last known values of fluxes and partial currents. The old expansion coefficients are used to transform (3–15) into an easily tractable lower triangular matrix system and, in case of heterogeneous nodes, to evaluate integrals containing space–dependent cross-sections. The total set of nodal balance equations can then be solved by a conventional fission source iteration process.

Figure 3.2-1: NEM-Relationship Between Nodal Cross-Sections, In-Currents, Fluxes and Out-Currents



The equations of the NEM approach converge to the continuous form of the multi-group diffusion equations as the mesh spacing is reduced to zero. The NEM-M2 expansion (Reference 3.10-1) is merely one variant in a larger class of efficient solution methods for this consistent set of equations. The nodal expansion approach, therefore, forms the basis for different variants of nodal methods that can be identified in the literature. These variants are typically hybrids of analytical and polynomial solution methods that were developed as extensions and further improvements of the original work, and are especially suitable for situations where steep thermal flux gradients occur at assembly interfaces. The semi-analytical hybrid NEM variant (recommended option in ARTEMIS) is outlined briefly in this section.

In any spatial direction u, the one-dimensional flux $\psi(u)$ is assumed to have the following shape (dropping all indices such as g for energy group)

[ ] (3-20)

In this representation of the intranodal direction-dependent flux shape, the coefficients A and B are to be determined by nodal interface boundary conditions. The 0th expansion coefficient, c_0, follows from the condition that the solution of the equivalent one-dimensional diffusion equation:

$$-D\frac{\partial^2\psi}{\partial u^2}+\Sigma_r(u)\psi(u)=S(u)-D\ L(u)$$
$$\gamma^2=D/\Sigma_r \tag{3-21}$$

is consistent with the nodal balance equation. [

] The semi-analytical solution method does preserve all the other favorable features of the polynomial NEM approach. Due to this and due to the enabled higher accuracy for situations where steep thermal flux gradients occur, the semi-analytical method is used as part of the standard default solution mode for both steady-state and transient computations.

3.3 *The 3D Multi-group Transient Flux Solver FLUXT*

The 3D multi-group transient flux solver FLUXT solves the multi-group space-time diffusion equation by the nodal expansion method. The steady-state solver FLUXS is used within FLUXT for solving the numerical external source problem that arises from the fully implicit time differencing scheme (Reference 3.10-2). The time-dependent nodal diffusion equations for node m are, in semi-discrete form:

$$\frac{1}{v_g}\frac{d\,\Phi_g^m}{dt} + \sum_{u=x,y,z}\frac{1}{a_u^m}\left[\left(J_{gul}^{-m}+J_{gur}^{+m}\right)-\left(J_{gul}^{+m}+J_{gur}^{-m}\right)\right]$$

$$+\left(\Sigma_{ag}^{m}+\sum_{g'\neq g}^{G}\Sigma_{g'g}^{m}\right)\Phi_{g}^{m}=\sum_{g'\neq g}^{G}\Sigma_{gg'}^{m}\Phi_{g'}^{m}$$

$$+\sum_{j=1}^{J}\left(1-\beta^{j}\right)\chi_{pg}^{j}\sum_{g'=1}^{G}\nu\Sigma_{fg'}^{jm}\Phi_{g'}^{m}+\sum_{i=1}^{I}\chi_{dg}^{i}\lambda_{i}C_{i}^{m}+\chi_{eg}s_{e}^{m} \qquad (3\text{-}22)$$

with,

$$\frac{dC_{i}^{m}}{dt}+\lambda_{i}C_{i}^{m}=\sum_{g'=1}^{G}\sum_{j=1}^{J}\beta_{i}^{j}\nu\Sigma_{fg'}^{jm}\Phi_{g'}^{m} \qquad (3\text{-}23)$$

and,

$$-D_{g}^{m}\left.\frac{\partial\Psi_{gu}^{m}}{\partial u}\right|_{s}=J_{gus}^{+m}-J_{gus}^{-m} \qquad (3\text{-}24)$$

using the previous notation except that the cross section subscript u has been dropped for convenience. The terms β_i^j, C_i and λ_i denote the delay fraction, concentration and decay constant per precursor group i, respectively. The total delayed fraction for nuclide j is defined by $\beta^{j}=\sum_{i}\beta_{i}^{j}$. The term s_e^m is the optional external source term.

Thus, the time dependent transverse integrated flux, Ψ_{gu}^{m}, translated into the equivalent 1D transient transverse integrated nodal diffusion equations (u = x, y, z) becomes:

$$\frac{1}{v_{g}}\frac{\partial\Psi_{gu}^{m}}{\partial t}-D_{g}^{m}\frac{\partial^{2}\Psi_{gu}^{m}}{\partial u^{2}}+\left(\Sigma_{ag}^{m}+\sum_{g'\neq g}^{G}\Sigma_{g'g}^{m}\right)\Psi_{gu}^{m}$$

$$=\sum_{g'\neq g}^{G}\Sigma_{gg'}^{m}\Psi_{g'u}^{m}+\sum_{j=1}^{J}\left(1-\beta^{j}\right)\chi_{pg}^{j}\sum_{g'=1}^{G}\nu\Sigma_{fg'}^{jm}\Psi_{g'u}^{m}$$

$$+\sum_{i=1}^{I}\chi_{dg}^{i}\lambda_{i}\zeta_{iu}^{m}-D_{g}^{m}L_{gu}^{m}+\chi_{eg}s_{e}^{m} \qquad (3\text{-}25)$$

$$\frac{\partial\zeta_{iu}^{m}}{\partial t}+\lambda_{i}\zeta_{iu}^{m}=\sum_{j=1}^{J}\beta_{i}^{j}\sum_{g'=1}^{G}\nu\Sigma_{fg'}^{jm}\Psi_{g'u}^{m} \qquad (3\text{-}26)$$

where ξ_{iu}^{m} is the transverse-integrated precursor concentration.

The term $D_g^m L_{gu}^m$ denotes the transverse leakage in which L_{gu}^m is approximated by:

[ ] (3-27)

The time derivatives of Ψ and ξ are replaced by dynamic frequencies:

[(3-28)

(3-29)]

It follows that:

[ ] (3-30)

Using these definitions and approximations and defining $b_{0gu}^{m} = \overline{L_{gu}^{m}}.$, we get:

[ ] (3-31)

where,

[ ]

$$\chi^j_{tg} = \chi^j_{pg}\left(1-\beta^j\right) + \sum_{i=1}^{I}\beta^j_i\chi^i_{dg} \tag{3-32}$$

and,

$$\Sigma^{jm}_{dgg'} = \sum_{i=1}^{I}\beta^j_i\,\chi^i_{dg}\,\nu\Sigma^{jm}_{fg'}\left(1-\frac{\lambda_i\,C^m_i}{\sum_{j=1}^{J}\beta^j_i\sum_{g'=1}^{G}\nu\Sigma^{jm}_{fg'}\,\Phi^m_{g'}}\right) \tag{3-33}$$

Truncation errors due to temporal differencing are reduced by the frequency transformation technique (Reference 3.10-2):

[ ] (3-34)

The Ω^m can be computed point-wise by:

[ ] (3-35)

typically, with the weight coefficients w_g chosen equal to 1. In this implicit Euler approach, the time derivative can hence be rewritten as:

[ ] (3-36)

and the solution of the precursor equations is approximated by:

[ ] (3-37)

Whereas in steady-state flux solution, the solution is stabilized by the neutronic eigenvalue λ, in the transient flux solution it is the nodal frequency distribution (representing the space-dependent rate-of-change) that numerically stabilizes the

transient NEM equation. More extensive information on the FLUXT transient solution methodology can be found in (Reference 3.10-2).

3.4 *Acceleration by Multi-level Coarse Mesh Rebalancing*

In the polynomial and the semi-analytical NEM variants, the iterative process to obtain the neutronics solution (whether steady-state or transient) is accelerated by a multi-level coarse mesh rebalancing (MLCMR) procedure (Reference 3.10-5). This typically achieves a substantial reduction of run time, thereby enabling favorable run times for both steady-state and transient computations. The applicability of the specific MLCMR approach adopted in FLUXS and FLUXT is conveniently invariant with respect to the exact setup of the NEM equations, as long as a clear nodal balance equation equivalent to the diffusion equation (thus featuring nodal fluxes, in-currents and out-currents) can be identified and used as a basis for restriction to a coarser space-energy mesh. This means that the available rebalancing routines can be used regardless of whether one solves second or higher-order polynomial NEM equations or semi-analytical variants of the NEM equation. Coarse mesh rebalancing provides a suppression of otherwise slowly decaying low-frequency non-fundamental mode components of the flux solution.

3.5 *Cross-Section Model*

The homogenized cross-sections used by ARTEMIS must represent as efficiently as possible the reaction rates that would be computed if a detailed description of the core (with its heterogeneities) and an accurate physics level (transport theory and slowing down in presence of resonances) was used. The cross-sections are generated using APOLLO2-A using homogenization in space and in energy. Discontinuity factors are

computed in order to enable equivalence to heterogeneous transport solutions. Since the result of the homogenization depends on the space and energy distribution of the flux in the local conditions of a node, the homogenized cross-sections are parameterized as a function of different state conditions:

- burnup, nuclide density
- moderator density
- B^{10} nuclide density (soluble boron)
- Xe^{135} nuclide density
- fuel temperature
- moderator temperature.

The cross-sections in these nodal conditions are represented as a superposition of three-dimensional B-Splines (Reference 3.10-6) and polynomials. Each physical quantity (i.e., cross-section) is represented as a linear combination of multidimensional tensor products of real-valued functions, each defined on a specific interval. These real-valued functions are either standard polynomials of order two or B-Splines of order three. The data points used to determine the polynomial coefficients are reproduced within the numerical round-off error. The physical quantity is twice continuously differentiable within the complete multidimensional domain. The multidimensionality chosen in the standard representation is three. The linear combination of multiple three-dimensional functions allows fitting to more than three parameters.

The implementation of the mathematical model is completely generic regarding the number of variables, the multidimensionality of the tensor products, the order of the B-Splines and the smoothness characteristics of the resulting representation.

The general equation of a cross-section is the following:

$$\Sigma_{r,g} = \sum_{i=1}^{N_{isot}} N_i \sigma_{r,g,i} \tag{3-38}$$

where N_i is the number density of isotope $i,(i=1,...,N_{isot})$. The cross-section $\sigma_{r,g,i}$ is a function of different parameters and is expressed as the following,

$$\sigma_{r,g,i}\left(p_1,p_2,...,p_{Nparam}\right)=\sum_j \sigma_{r,g,i,j}\left(Selection_j\left(p_1,p_2,...,p_{Nparam}\right)\right) \quad (3\text{-}39)$$

where $Selection_j\left(p_1,p_2,...,p_{Nparam}\right)$ represents a combination of parameters among $p_1,p_2,...,p_{Nparam}$. The term $\sigma_{r,g,i,j}\left(Selection_j\left(p_1,p_2,...,p_{Nparam}\right)\right)$ represents the dependence of the cross-section on the conditions assessed by selection *j*, while the parameters not belonging to the selection are set to a reference value. The functions $\sigma_{r,g,i,j}$ are interpolation functions based on combinations of B-splines and polynomials.

3.6 *Nuclide Depletion*

Standard input files define the various nuclide chains and the yield matrix for the ARTEMIS depletion solver. The nuclide data defined for reactor applications is generated to be consistent with:

- the primary data of the spectral code used for library generation (e.g., regarding chain structure, fission yields and decay constants, branching ratios …)
- and the set of cross-section (XS) libraries used by the reactor calculation (e.g., regarding the nuclide set used in each library …).

On the basis of these files, the following linear first order system of coupled ordinary differential equations is set up:

$$\frac{dn_j}{dt}=\sum_{k=1}^{N} M_{jk} n_k \qquad for\ j=1,2,...,N. \quad (3\text{-}40)$$

Here $n_j(t)$ is the density of nuclide j at time t. The depletion matrix element M_{jk} describes the specific rate of transmutation of nuclide *k* into nuclide *j*:

[ ] (3-41)

where,

- λ_{jk} = decay constant for production of nuclide j from the decay of nuclide k (note that λ_{jj} is a negative, or loss term, for the decay of nuclide j)
- Y_{jk} = fission yield of nuclide j from the fission of fuel nuclide k (note that Y_{jj} is defined as -1.0 to produce a loss from fission in nuclide j)
- $\sigma_{f,kg}$ = microscopic fission cross-section of fuel nuclide k in group g

[ ]

- Φ_g = neutron flux in group g

The resolution of the equations (3-40) over a time step is achieved using an efficient Krylov subspace solver (Reference 3.10-7).

3.7 *Pin Reconstruction*

The pin reconstruction (dehomogenization) process is used to calculate the cell flux, fuel rod power, fuel rod burnup, and detector reaction rate. This process is based on the nodal flux solution and data constants obtained during the generation of the cross-section library with APOLLO2-A. The nodal flux solution provides the node-average and surface-average fluxes for each node, but the fluxes at the corners of the nodes are not directly available. It is assumed that the two-dimensional flux can be expressed in terms of the one-dimensional transverse-integrated fluxes as follows:

$$\phi_g(x,y) = \psi_{g,x}(x) + \psi_{g,y}(y) - \bar{\phi}_g \qquad (3\text{-}42)$$

For each node in the core, the homogeneous corner point flux estimate is thus given by the following:

$$\phi_g^{c,\hom,est} = \psi_g^{s,\hom,x} + \psi_g^{s,\hom,y} - \bar{\phi}_g \tag{3-43}$$

where, the superscripts *c* and *s* denote corner and surface-average values, respectively.

The heterogeneous corner point flux estimate is determined from the product of the homogeneous corner point estimate and the corner point discontinuity factor (CPDF) obtained from single assembly APOLLO2-A calculations:

$$\phi_g^{c,het,est} = \phi_g^{c,\hom,est} \frac{\phi_{g,AP2}^{c,het}}{\phi_{g,AP2}^{c,\hom}} = \phi_g^{c,\hom,est} \cdot CPDF_g \tag{3-44}$$

The heterogeneous corner point flux is defined to be the average of the four heterogeneous corner point estimates about a given corner:

$$\phi_g^{c,het} = \frac{\sum_{i=1}^{4} \phi_g^{c,het,est}}{4} \tag{3-45}$$

The homogeneous corner point flux is determined by dividing the heterogeneous corner point flux by the corner point discontinuity factor for each quadrant. Thus, the homogeneous corner point flux is discontinuous across the nodal boundaries:

$$\phi_{m,g}^{c,\hom} = \frac{\phi_g^{c,het}}{CPDF_{m,g}} \tag{3-46}$$

The intra-nodal flux distributions in the fast group are assumed to have the following form. The notation includes fast groups that range from group 1 to group G_f. For the

reactor application benchmarks described in this report, there is one fast group and one thermal group (two energy groups).

$$\phi_g^{\text{hom}}(u,v) = \sum_{i,j=0}^{4} a_{ij} f_i(u) f_j(v) \tag{3-47}$$

The variables u and v are the dimensionless *x* and *y* variables within the node. The expansion functions are the following polynomial forms.

$$f_{g,0}(u) = 1$$
$$f_{g,1}(u) = u \qquad f_{g,2}(u) = u^2 - \tfrac{1}{12}$$
$$f_{g,3}(u) = \left(u^2 - \tfrac{1}{4}\right)u = u^3 - \tfrac{u}{4} \qquad f_{g,4}(u) = \left(u^2 - \tfrac{1}{4}\right)\left(u^2 - \tfrac{1}{20}\right) = u^4 - \tfrac{3}{10}u^2 + \tfrac{1}{80}$$

The variables a_{ij} are the unknown expansion coefficients.

The intra-nodal flux distributions in the thermal groups are assumed to have the following form:

$$\phi_g^{\text{hom}}(u,v) = c_{00} \sum_{g=1}^{G_f} \phi_g^{\text{hom}}(u,v) + \sum_{\substack{i,j=0 \\ i=j\neq 0}}^{4} c_{ij} b_{g,i}(u) b_{g,j}(v) \tag{3-48}$$

The variables c_{ij} are the unknown expansion coefficients.

The thermal flux expansion functions are defined to be the following:

$$b_{g,0}(u) = 1$$
$$b_{g,1}(u) = \sinh\left(\frac{\kappa_g u}{\sqrt{2}}\right) \qquad b_{g,2}(u) = \cosh\left(\frac{\kappa_g u}{\sqrt{2}}\right)$$
$$b_{g,3}(u) = \sinh(\kappa_g u) \qquad b_{g,4}(u) = \cosh(\kappa_g u)$$
$$\kappa_g = \sqrt{\frac{h^2 \Sigma_{rg}}{D_g}}$$

The constants a_{ij} and c_{ij} are evaluated using the above equations with constraints imposed from the nodal solution. The homogeneous flux within each pin cell is evaluated by integration of the flux expansion over the volume of interest. For cell *n* in location *x,y* within the node, the following equation is used:

$$\phi_{g,n}^{\text{hom}} = \iint_A \phi_g(u,v)\,du\,dv \tag{3-49}$$

The integration is over the area, A, of the pin cell *n*, with $-\frac{1}{2} \leq u,v \leq \frac{1}{2}$.

The energy production cross-section ($\kappa\Sigma_{f,g,n}$) for group g and location n within the fuel assembly is calculated by integration over the cell area. The intra-nodal cross-section is modeled by a bi-quadratic distribution. The distribution is based on the node-average cross-section and the four surface-average cross-section values in the *x* and *y* directions. The surface cross-sections account for burnup gradients that occur during depletion. The intra-nodal (homogeneous) power is determined from the pin cell average fluxes and cross-sections.

$$P_n^{\text{hom}} = \sum_g \kappa\Sigma_{f,g,n}\phi_{g,n} \tag{3-50}$$

The local pin power for cell *n* is expressed as the product of the intra-nodal power distribution and single assembly power form functions. The power form functions are generated from APOLLO2-A calculations and stored in the cross-section library.

$$P_n = P_n^{\text{hom}} f_n^{pow} \tag{3-51}$$

Fuel rod burnup is evaluated by integration of the fuel rod power over each depletion step.

Detector reaction rates are calculated using the homogeneous cell fluxes, the detector flux form factors, and the detector cross-sections. The detector flux form factors and the detector cross-sections are obtained for each energy group from the cross-section

library. The following equations apply to a single axial location within a single fuel assembly. The location of the detector within the assembly is not limited and may consist of more than one cell. First, the average homogeneous flux in the pin cells comprising the detector is determined:

$$\bar{\phi}_g^{\text{hom}} = \frac{\sum_{n'=1}^{N} \phi_{g,n'}^{\text{hom}}}{N} \qquad (3\text{-}52)$$

The subscript n' denotes those pin cells that comprise the detector with a total of N cells. The detector reaction rate is calculated using the following equation with the term $f_g^{\det}$ denoting the detector flux form factor.

$$R^{\det} = \sum_{g=1}^{G} \bar{\phi}_g^{\text{hom}} f_g^{\det} \Sigma_g^{\det} \qquad (3\text{-}53)$$

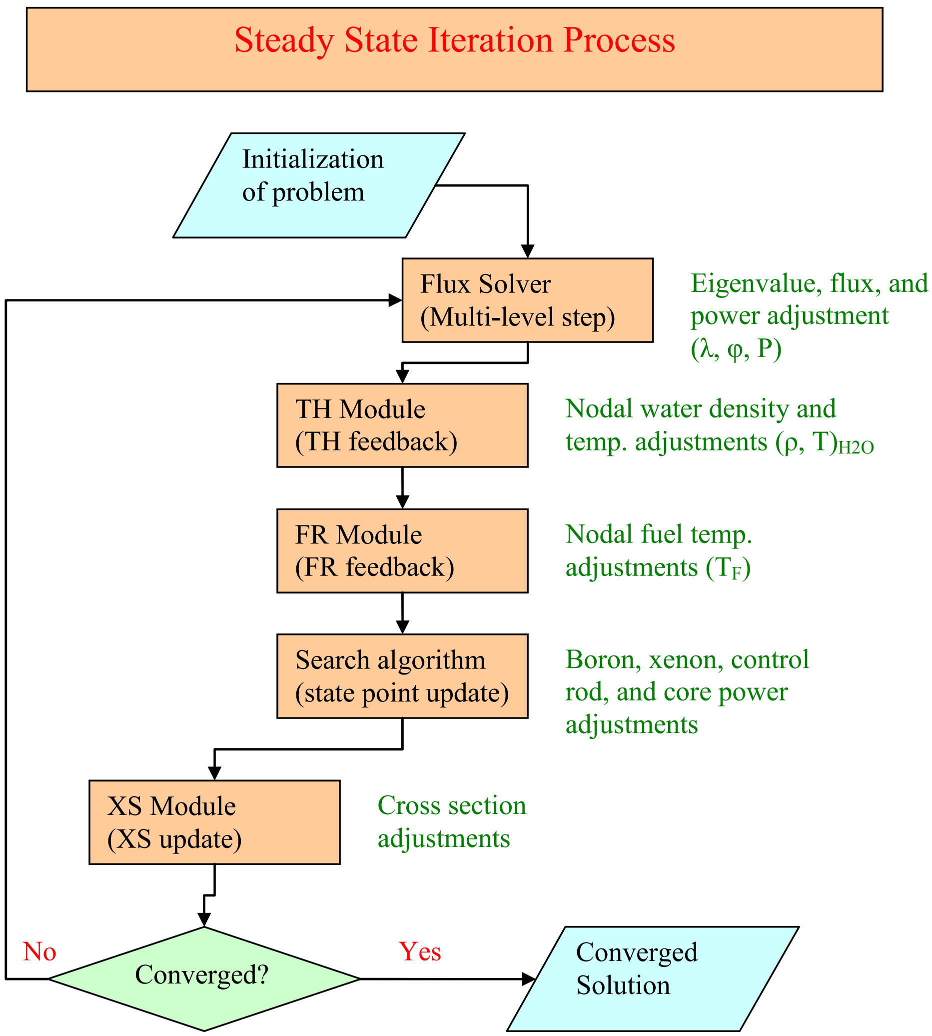
3.8 *Coupled Neutronic, Thermal-Hydraulic, and Fuel Rod Calculations*

The ARTEMIS code solves the nodal balance equation in three dimensions to determine the flux, source, relative power density and reactivity of a reactor core. Each node in the problem is allowed to contain cross-sections which vary in response to changes in the solution. This poses a non-linear system which is solved iteratively using a convergence algorithm.

Several levels of iteration are used in the convergence algorithm. The innermost iterations are within the flux solver and include the updates to the fluxes, currents and fission source based on the current state values for each node and are commonly referred to as the inner iterations. These iterations are based on the current set of cross-section values. The outer iterations consist of updates to the various state values based on the current flux solution. These include the moderator and fuel properties, boron nuclide density, and xenon nuclide density. Cross-sections are evaluated based on the updated state conditions. Figure 3.8-1 provides a diagram of the convergence

process for steady state calculations. This process continues until all convergence criteria have been satisfied.

Figure 3.8-1: Steady State Iteration Process



Steady state and core transient calculations require the coupling of neutronic, fuel rod, and thermal-hydraulic models. The neutronic model evaluates the cross-sections, computes the three-dimensional flux shape, and calculates the power. Inputs to the

model are the control rod position, fuel temperature, water density, boron concentration and the neutron flux time-step. Outputs are the power generated in the fuel and the power directly deposited in the water.

The fuel rod module calculates the fuel rod properties and the fuel rod temperatures. Inputs are the power generated in the fuel, the power shape within the pellet, the cladding wall temperature, and the fuel model time-step. Outputs are the Doppler fuel temperatures and the heat flux at the surface of the cladding. Details of the fuel rod module are provided in Chapter 5.

The thermal-hydraulic model solves the mass/energy balance equations and calculates water properties. Inputs are the heat flux at the surface of the cladding, the power directly deposited in the water, the inlet coolant temperatures, the inlet volumetric coolant flow rates, system pressure and the thermal-hydraulic time-step. Details of the thermal-hydraulic model are provided in Chapter 4.

3.9 *Fuel Assembly Shuffling and Repository*

The fuel assembly shuffling and repository module is termed POSEIDON. It is a tool to handle an assembly repository containing the currently loaded, fresh and discharged fuel assemblies. Concerning the shuffling process, this tool allows for moving fuel assemblies within the core, discharging fuel assemblies to the repository, loading fresh fuel assemblies and inserting previously discharged fuel assemblies from the repository into the core.

The repository data file contains a complete history of all fuel assemblies which have been used at a plant site, including the reactor core, pool and dry storage. Fuel assemblies from multiple reactors can be maintained in the same repository file. The accumulated history information and the fuel assembly characteristics (burnup, nuclide densities, etc.) are updated each cycle. A list of fuel assemblies and their properties can be generated from the repository file.

3.10 *References*

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4.0 ARTEMIS (COBRA-FLX) THERMAL-HYDRAULIC METHODOLOGY

4.1 *Introduction*

The thermal-hydraulic program COBRA-FLX is capable of performing 3D steady-state, transient full-core, and subchannel analyses. COBRA-FLX has been integrated into ARTEMIS to have the ability to solve complex two-phase flow problems and to improve consistency and efficiency with the thermal-hydraulic cross flow design tool. Geometry specifications for the reactor core are flexible, relying on information about flow areas and lateral interconnections, without reliance on any particular coordinate system.

The basic conservation equations of the two-phase flow are written for the mixture quantities in time-dependent, 1D form. Cross-flow effects are taken into account by additional terms included in these basic equations. The code solves the flow field equations as boundary value problems. Enthalpy and mass flow at the core inlet serve as boundary conditions for the energy and continuity equations. Also the axial momentum equation is treated as a boundary value problem, using the core exit pressure. Both temporal and spatial acceleration are accounted for in the cross-flow momentum equation. Separated slip flow is assumed in each subchannel, and the void fraction distribution is evaluated as a function of enthalpy, flow rate, heat flux and pressure. Several correlations for subcooled void fraction are present in the code. This permits the effect of void formation on flow resistance to be accounted for and void fraction limits to be assessed.

Fuel pin temperatures for use with COBRA-FLX are calculated by the Fuel Rod Module (FRM). For details of the FRM see Chapter 5.

COBRA-FLX offers a choice of different correlations selected by the user. Some of them are necessary to close the system of equations to be solved; others define specific evaluations of calculated results. Correlations to be selected include friction factor, inter-subchannel mixing, resistance to transverse flow, and critical heat flux correlations.

Any transient calculation will start from an established converged steady-state solution. Time-dependent changes can be specified for the heat flux or, if a fuel rod model is employed, for the power generation rate. Boundary conditions for system pressure, as well as for coolant mass flow and temperature (enthalpy) at the inlet may be defined as functions of time. Time step widths can be automatically determined after checking of the behavior of relative changes to the thermal-hydraulic solutions during time steps.

In ARTEMIS the main task of COBRA-FLX is to provide the moderator temperature and density by node for updating the neutron cross-sections during the flux iteration in coupled neutronic / thermal-hydraulic steady-state and transient applications.

4.2 *COBRA-FLX Description*

4.2.1 Problem Formulation

Conservation equations of two-phase flow are written for mixture quantities in time-dependent form.

The conservation equations for mass, momentum and energy are basically 1D in the axial (x-) direction. However, lateral mixing between subchannels is accounted for by considering two types of cross-flow. Diversion cross-flow results from lateral pressure differences due, for instance, to differing hydraulic conditions. It is superimposed by turbulent cross-flow between adjacent subchannels, with no net mass exchange but with contributions to energy and axial momentum balances. For simplicity's sake, the resulting basic conservation equations are expressed for a subchannel i connected to only one adjacent subchannel j. In the general form all the cross-flow related terms (index ij) have to be evaluated by summation over all the neighboring subchannels. The equations read as follows (refer to the Equation Nomenclature (page xiv) for a list of symbols and their meanings):

The continuity equation:

$$A_i \frac{\partial \rho_i}{\partial t} + \frac{\partial m_i}{\partial x} = -w_{ij} \qquad (4\text{-}1)$$

states the mass balance taking into account the diversion cross-flow w_{ij} per unit length. It is defined positive when flow is leaving subchannel i. The turbulent cross-flow does not appear because it does not constitute a net mass exchange.

On the left-hand side of the energy equation:

$$\frac{1}{u''}\frac{\partial h_i}{\partial t} + \frac{\partial h_i}{\partial x} = \frac{q'_i}{m_i} - \left(h_i - h_j\right)\frac{w'_{ij}}{m_i} - \left(T_i - T_j\right)\frac{c_{ij}}{m_i} + \left(h_i - h^*\right)\frac{w_{ij}}{m_i} \qquad (4\text{-}2)$$

u” represents an effective velocity for energy transport. On the right, turbulent cross-flow w'_{ij} contributes through the difference in enthalpy between channels i and j. Similarly, the diversion cross-flow w_{ij} carries the enthalpy h* of the donor channel. Thermal conduction due to temperature differences is accounted for by the third term, whereas the first one gives the heat transfer from the fuel rods (q’ is the linear heat flux on the surface).

The turbulent cross-flow is determined based on user-supplied information specifying a turbulent mixing parameter Thermal Diffusion Coefficient (TDC) in single-phase and two-phase conditions. This information usually is derived from special mixing experiments.

On the left-hand side of the axial momentum equation appears:

$$\frac{1}{A_i}\frac{\partial m_i}{\partial t} - 2u_i\frac{\partial \rho_i}{\partial t} + \frac{\partial p_i}{\partial x} =$$

$$- \left(\frac{m_i}{A_i} \right)^2 \left[\frac{v_i \, f_i \, \Phi_i}{2 \, D_i} + \frac{k_i \, v'_i}{2 \, \Delta x} + A_i \frac{\partial}{\partial x} \left(\frac{v'_i}{A_i} \right) \right]$$

$$- \rho_i \; g_c \; \cos \Theta \; - \; \frac{f_T}{A_i} \left(u_i - u_j \right) \; w'_{ij} + \frac{1}{A_i} \left(2 \, u_i - u^* \right) w_{ij} \qquad (4\text{-}3)$$

the axial pressure gradient and its transient components. Again, on the right-hand side turbulent and diversion cross-flow contribute, due to differences in subchannel flow velocities u and cross-flow velocity u*, respectively. Besides those contributions, the equation considers friction, spatial acceleration and elevation pressure drop terms.

The transverse momentum equation:

$$\frac{\partial w_{ij}}{\partial t} + \frac{\partial \left(u^* \; w_{ij} \right)}{\partial x} + \left(\frac{s}{l} \right) C_{ij} \; w_{ij} = \left(\frac{s}{l} \right) \left(p_i - p_j \right) \qquad (4\text{-}4)$$

governs the momentum coupling between two adjacent subchannels. Cross-flow temporal and spatial acceleration are supplemented by friction and pressure terms. Their relative importance against inertia terms is expressed by the transverse momentum parameter (s/l). By setting this parameter to zero the code switches off cross-flow. This application is then equivalent to a conventional parallel channel model.

In common with most subchannel codes, COBRA-FLX allows an arbitrary arrangement of channels and, therefore, does not explicitly preserve transverse momentum over distances more than a subchannel width. Its use is therefore limited to mainly axially directed flows. Nevertheless, COBRA-FLX can handle situations such as flow diversion due to partial subchannel blocking.

In addition to these conservation equations, an equation of state (e.g., steam tables) describes the two-phase fluid density in dependence of pressure, mixture enthalpy and flow rate. A variety of correlations and models complete the system of equations and are provided for optional use. This includes correlations for single-phase friction factor

and corresponding two-phase multiplier, spacer loss coefficient, and bulk and subcooled boiling void fraction. With respect to cross-flow calculation, empirical models serve for determining forced as well as turbulent single- and two-phase mixing, and for specification of the parameters appearing in the transverse momentum equation. A very detailed and extensive description of the features of COBRA-FLX, as well as verification and validation, is provided in Reference 4.5-1.

4.2.2 Code Structure

Figure 4.2-1 gives an overview on the high-level code solution logic of COBRA-FLX. Details of the code structure are discussed in Reference 4.5-1.

4.3 *COBRA-FLX Coupling With ARTEMIS*

COBRA-FLX is the Thermal-Hydraulic Module (THM) of ARTEMIS. Within ARTEMIS the THM together with the Fuel Rod Module (FRM) are used in steady-state and transient calculations for:

- generating the required information needed for the cross-section updates during the flux iteration process
- thermal-hydraulic evaluation of the power density distribution resulting from a converged flux solution.

Principles of the thermal-hydraulic evaluations performed with ARTEMIS are described in the COBRA-FLX Topical Report (Reference 4.5-1). The functionality described here is the coupling to the FRM. The interfaces between neutronics, THM and FRM, are described in Chapter 3 of this report.

4.3.1 Development of Thermal-Hydraulic Parameters That Are Used in Coupling and Their Nodal Basis

The 3D nuclear core calculations with ARTEMIS are generally performed in a coarse mesh representation (e.g., radially 1 or 4 nodes per fuel assembly). Input to the THM is a geometrically detailed 3D pin-by-pin representation of the fuel assemblies as it is

required for the evaluation of safety parameters. Providing the feedback parameters for the cross-section updates in the nodal calculations needs a well defined procedure for the determination of a representative channel for each coarse node. Figure 4.3-1 shows the definition of the different cell types of a fuel assembly. The formula for calculating the characteristics of each cell are defined in Figure 4.3-2. The representative channel is generated by determining the flow area $S_{Assembly}$ (equation 4-5) and the wetted and heated perimeter $P_{Assembly}$ (equation 4-6) with the following formula:

$$S_{Assembly} = \sum_{i} N_i S_i \tag{4-5}$$

$$P_{Assembly} = \sum_{i} N_i P_i \tag{4-6}$$

with N_i: number of subcells of type i in the assembly
i: cell type (typical cell, guide tube cell, border or corner cell).

The same representative channel is used for each radial node of a fuel assembly in case of mesh refinements in the neutronic calculation. The representative channel is used for generating the required data for updating the neutron cross-section during the flux iteration: node-average coolant temperature, coolant density and void fraction.

The generation of 'nodal' fuel temperatures for steady-state calculations or heat transfer coefficients for transient calculations is described in Chapter 3.

4.3.2 One-way and Two-way Coupling

For thermal-hydraulic evaluations the THM/FRM can be applied in stand-alone mode or coupled with the neutronic calculation. Both applications are possible in either steady-state or transient solutions.

4.4 Safety Margin Evaluation

In both steady-state and transient calculations, the coupled THM/FRM yields thermal-hydraulic results for each flow channel node. These results reflect the influences of boundary conditions (exit pressure, inlet mass flow and temperature), of power distribution and of ensuing cross-flow between neighboring channels. For safety-related analyses, thermal results are calculated and checked against the maximum permissible values in order to determine thermal margins. These thermal-hydraulic evaluations with ARTEMIS are described in the COBRA-FLX Topical Report (Reference 4.5-1).

4.5 References

4.5-1 ANP-10311, Rev. 0, COBRA-FLX: Core Thermal-Hydraulic Analysis Code

Figure 4.2-1: COBRA-FLX High Level Solution Logic

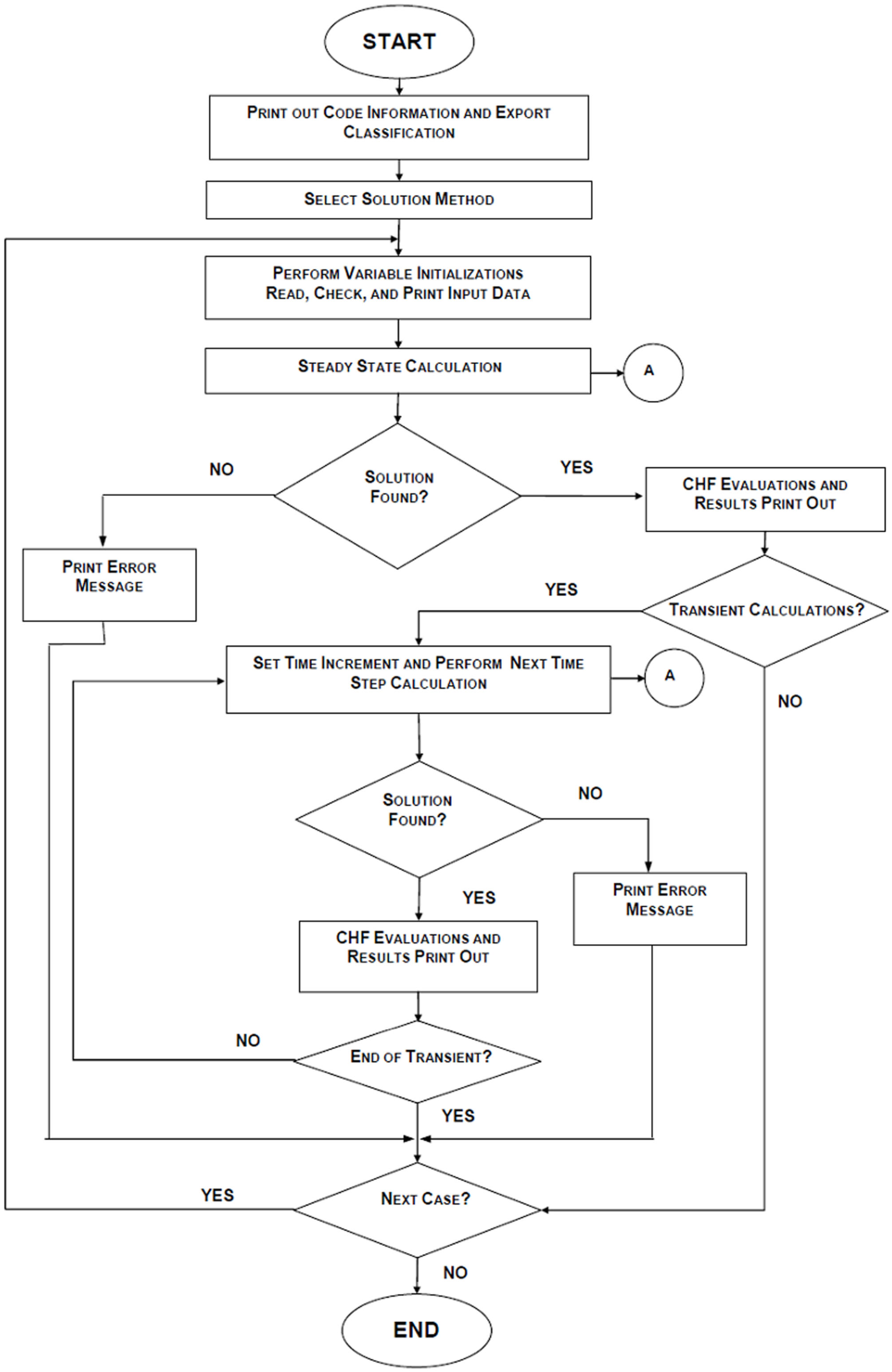


Figure 4.3-1: Different Types of Cells

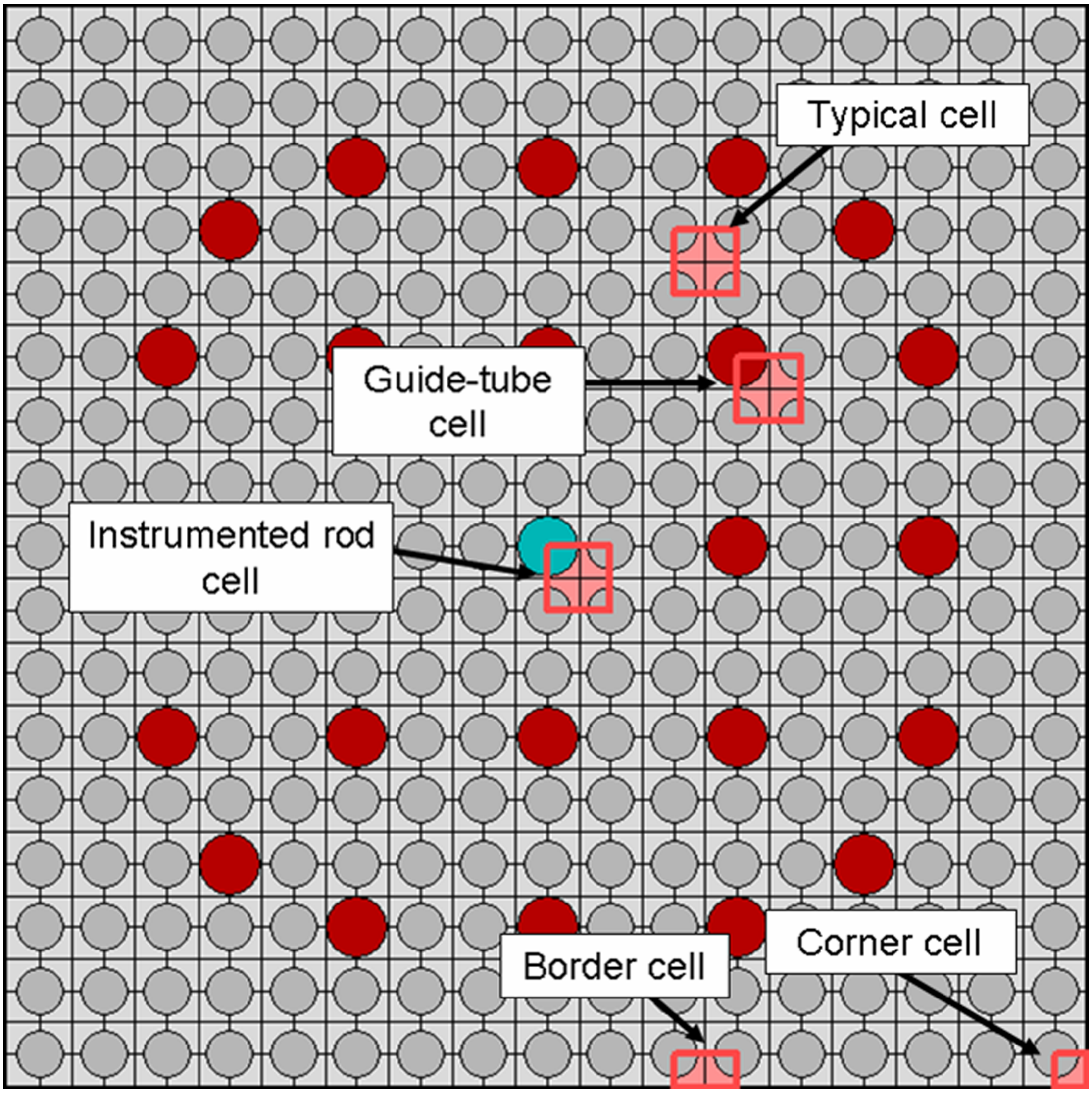
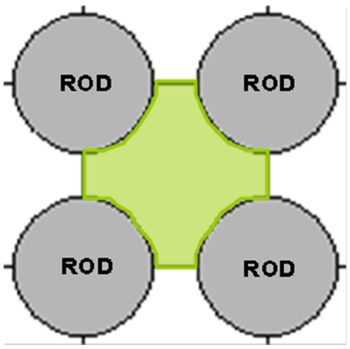


Figure 4.3-2: Calculation of Flow Area, Wetted and Heated Perimeter

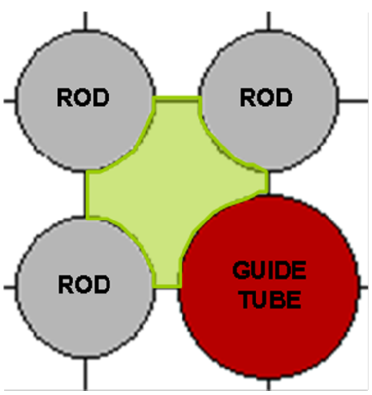
Typical Cell



$$S_{typ} = rod\_pitch^2 - \frac{\pi D_{rod}^2}{4}$$

$$P_{wet,typ} = P_{heated,typ} = \pi D_{rod}$$

Guidetube or Instrumentation Tube Cell



$$S_{GT} = rod\_pitch^2 - \frac{3}{16}\pi D_{rod}^2 - \frac{1}{16}\pi D_{GT}^2$$

$$P_{wet,TG} = \frac{3}{4}\pi D_{rod} + \frac{1}{4}\pi D_{GT}$$

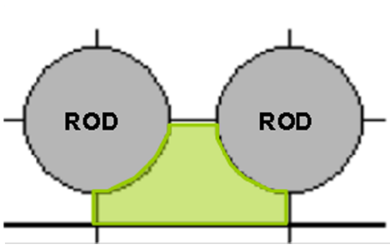
$$P_{heated,TG} = \frac{3}{4}\pi D_{rod}$$

Legend:

rod_pitch:	Rod center distance
D:	Outer diameter
N:	Number of cells along one side of the fuel assembly

Figure 4.3-2: Calculation of Flow Area, Wetted and Heated Perimeter (cont'd.)

Border Cell



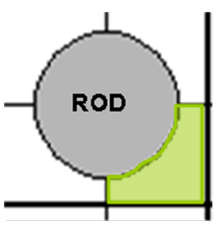
$$S_{border} = rod\_pitch * \frac{\left(assembly\_pitch - \left(N_{rod} - 1\right) * rod\_pitch\right)}{2} - \frac{1}{8}\pi D_{rod}^{2}$$

$$P_{heated,\ border} = \frac{1}{2}\pi D_{rod}$$

$$P_{wet,\ border\ \ FA} = P_{heated,\ border} = \frac{1}{2}\pi D_{rod}$$

$$P_{wet\ \ border\ \ vessel} = \frac{1}{2}1\pi D_{rod} + rod\_pitch$$

Corner Cell



$$S_{corner} = \frac{\left(assembly\_pich - \left(N_{rod} - 1\right) * rod\_pitch\right)^{2}}{4} - \frac{1}{16}\pi D_{rod}^{2}$$

$$P_{heated,\ border} = \frac{1}{2}\pi D_{rod}$$

$$P_{wet,\ corner\ \ FA} = P_{heated,\ corner} = \frac{1}{4}\pi D_{rod}$$

$$P_{wet\ \ corner\ \ vessel} = \frac{1}{4}\pi D_{rod} + \left(assembly\_pich - \left(N_{rod} - 1\right) * rod\_pitch\right)$$

Remark:
Two kinds of border or corner cells have to be considered for determination of the wetted perimeter:

- the cell is located next to a fuel assembly or
- the cell is located next to the reactor core baffle

5.0 ARTEMIS FUEL ROD MODULE METHODOLOGY

5.1 *Introduction*

The Fuel Rod Module (FRM) in the ARTEMIS code system solves both the static and time dependent one dimensional thermal equations for the fuel rods to calculate the fuel temperature distribution and heat flux to the coolant. The fuel effective temperature calculated from the pellet temperature distribution is used for interpolation of neutronic cross-sections. The heat flux from the fuel rods is used by the Thermal Hydraulic Module (THM) as boundary conditions to calculate the moderator density and temperature.

The FRM solves the heat transfer equation:

$$-\frac{1}{r}\frac{\partial}{\partial r}\left[r\cdot\lambda(r)\cdot\frac{\partial T(r,t)}{\partial r}\right]+\rho(r)\cdot C_p(r)\cdot\frac{\partial T(r,t)}{\partial t}=q(r,t) \qquad (5\text{-}1)$$

Where,

- t — time dependency,
- r — space dependency,
- T(r,t) — local temperature,
- $\lambda(r)$ — local thermal conductivity,
- $q(r,t)$ — local source term,
- $C_p(r)$ — local specific heat,
- $\rho(r)$ — local density

This equation is solved on an average fuel rod for the node which is composed of a cylindrical (or annular) fuel pellet (in which a fraction of the nuclear power is deposited), a gap characterized by a capacity to transmit heat, the cladding (not limited to only Zirc clad), and a coolant boundary condition. Solution of this equation also depends on conditions provided by the other modules of the core simulator:

- the THM provides the FRM with coupling data related to the coolant,
- the neutronics module provides the FRM with the power produced by the rod,
- the depletion module provides the FRM with the average burnup of the different slices to obtain the thermal properties of the fuel and the power within the fuel pellet.

5.2 *Thermal Solver*

The heat transfer equation leads to the following formulation, assuming that the equation is integrated in space, from the middle of the inner gap to the middle of the outer gap of a given ring i: $\left[r_i^{gap-inner}, r_i^{gap-outer}\right]$, and in time $\left[t_k, t_{k+1} = t_k + \Delta t\right]$:

$$HeatFluxTerm_i + PinStorageTerm_i = SourceTerm_i - ModeratorStorageTerm_i$$

$$SourceTerm_i \equiv \frac{1}{\Delta t}\int_{t_k}^{t_k+\Delta t} dt \int_{r_i^{gap-inner}}^{r_i^{gap-outer}} q(r,t)\cdot r\cdot dr \quad HeatFluxTerm_i \equiv \frac{1}{\Delta t}\int_{t_k}^{t_k+\Delta t} dt \int_{r_i^{gap-inner}}^{r_i^{gap-outer}} \frac{1}{r}\frac{\partial}{\partial r}\left(r\cdot\Phi(r,t)\right)\cdot r\cdot dr$$

$$ModeratorStorageTerm_i \equiv \frac{1}{\Delta t}\int_{t_k}^{t_k+\Delta t} dt \int_{r_i^{gap-inner}}^{r_i^{gap-outer}} \rho(r,t)C_p(r,t)\frac{\partial T_{out}}{\partial t}(t)\cdot r\cdot dr$$

$$PinStorageTerm_i \equiv \frac{1}{\Delta t}\int_{t_k}^{t_k+\Delta t} dt \int_{r_i^{gap-inner}}^{r_i^{gap-outer}} \rho(r,t)C_p(r,t)\frac{\partial \hat{T}}{\partial t}(r,t)\cdot r\cdot dr$$

Where,

- Φ(r,t) local heat flux,
- $\hat{T}(r,t) = T(r,t) - T_{out}(t)$ reduced temperature variable.

The boundary conditions are:

- At $r = r_{in}$ the heat transfer is assumed null: $\Phi(r = r_{in}) = \Phi_{in} = 0$,
- At $r = r_{out}$ Dirichelet or Fourier condition are possible.

The following assumptions have been made to build the thermal solver:

- Geometry Assumptions:

The rod geometry considered is cylindrical in 1D. The pellet is split into N rings. A gap is allowed between two successive rings. No gap is modeled on the inner side of the first ring and on the outer side of the last ring.

- Contact Resistance and Gap Assumptions:

  For each gap, even of null thickness, a contact resistance can be defined. The physical assumptions concerning the gaps are that they do not produce or store energy and that they are pure resistances.

A tri-diagonal matrix of the following form is thus obtained to solve the global thermal problem within a node:

$$\begin{pmatrix} -\alpha_1 & A_1 & & & & & & & \\ B_2 & -\alpha_2 & A_2 & & & & & & \\ & \ddots & \ddots & \ddots & & & & & \\ & & B_{i-1} & -\alpha_{i-1} & A_{i-1} & & & & \\ & & & B_i & -\alpha_i & A_i & & & \\ & & & & B_{i+1} & -\alpha_{i+1} & A_{i+1} & & \\ & & & & & \ddots & \ddots & \ddots & \\ & & & & & & B_{N-1} & -\alpha_{N-1} & A_{N-1} \\ & & & & & & & B_N & -\alpha_N \end{pmatrix} \cdot \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_{i-1} \\ X_i \\ X_{i+1} \\ \vdots \\ X_{N-1} \\ X_N \end{pmatrix} + \begin{pmatrix} C_1 \\ C_2 \\ \vdots \\ C_{i-1} \\ C_i \\ C_{i+1} \\ \vdots \\ C_{N-1} \\ C_N \end{pmatrix} = 0$$

The numerical solution of the system implemented in the FRM is based on a Gauss elimination algorithm.

5.3 *Physical Properties*

The physical properties used by the thermal equations in the FRM are discussed below.

- Radial Power Distribution

  The power source term of the thermal equation varies by radial ring and is contained in a pre calculated table format in terms of a Radial Power Density

(RPD) as a function of pellet radius. It is fitted based on burnup and wt% U235 and represents the relative power produced within each radial ring.

- Porosity

  Porosity is needed for the calculation of the thermal conductivity in the fuel which is primarily a function of initial density and burnup.

- Gap Conductance

  The gap conductance is implicitly modeled in the FRM, by using pre-calculated fitting tables representing the conditions expected during operation and accident conditions. The gap conductance represents the gap's ability to transmit heat from the pellet to the clad.

  The gap conductance tables contain values tabulated with respect to burnup,

  [ ]

- Thermal conductivity

  The thermal conductivity is calculated for each node using empirical correlations that depend on temperature, pellet material, burnup, porosity, and pellet composition. It should be noted that since the thermal conductivity depends on the temperature, a convergence loop is required between the calculation of the thermal conductivity and the calculation of the temperature by the thermal solver.

- Specific Heat

  The specific heat C_p is needed for the transient calculations. It is calculated using material empirical correlations that depend on the temperature and the material content.

- Material Density

  The material density is a user input.

- Effective temperature

  The effective temperature is an output of the FRM, and is used as a state parameter for the cross-section interpolation. This effective temperature is calculated the following way by the FRM:

  [ ] (5-2)

Empirical correlations for the physical properties can be obtained from any thermal-mechanical fuel performance code and they are used as equations directly in the FRM. The applicability and validation of the thermal properties are discussed in Chapter 9.

6.0 APOLLO2-A VALIDATION

6.1 *Introduction*

The validation of APOLLO2-A consists of comparisons of calculated results to measurements (physical validation). This chapter documents the ability of APOLLO2-A to accurately calculate reactivity, fission rate distributions, and isotopic depletion for a wide range of applications.

The reactivity calculation of APOLLO2-A is validated against both measurements in the critical experiments (sub-section 6.2) and single-cell representations (sub-section 6.3). Fission rate distributions calculated by APOLLO2-A are validated against measurements in critical experiments (sub-section 6.2). Finally, the isotopic depletion of APOLLO2-A is validated against measurements (sub-section 6.4).

All of the calculations in this chapter, except for the KRITZ critical experiment and VALDUC integral experiment, were performed with the standard cross-section library based on the JEFF3.1.1 evaluation as well as the calculation scheme that is used in industrial assembly calculations. Small deviations from this approach for KRITZ and VALDUC are discussed in the respective sub-sections.

6.2 *Critical Experiments*

This sub-section presents the benchmarking of APOLLO2-A against several sets of critical experiments. The experiments come from several international experimental programs, including Babcock and Wilcox (B&W) in the US, KRITZ in Sweden, and two experimental programs – EPICURE and CAMELEON – from the Commissariat à l’Energie Atomique (CEA) in France. All of these critical experiments are UO_2 fueled experimental reactors. The configurations were selected in order to support a wide range of validation; this range includes several U235 enrichments, several absorber materials including gadolinia, guide-tube configurations, void conditions, and fuel/moderator temperatures. All of the experiments were modeled completely within APOLLO2-A, which allows for the calculation of such large array problems; however,

the maximum number of flux iterations within the solvers was increased for these calculations to allow for numerical convergence.

6.2.1 Description of the Experimental Configurations

6.2.1.1 *Babcock and Wilcox*

Two sets of B&W experiments were performed, one during the 1970's (Reference 6.5-1) and one during the 1980's (Reference 6.5-2). Both sets of experiments were performed at B&W's Lynchburg Research Center; the purpose of the 1970's experiments was to measure the effect of lattice heterogeneities and the purpose of the 1980's experiments was to measure the effect of gadolinia.

The geometrical pin arrangement of these experiments was modeled after realistic PWR reactors, with 15x15 B&W, 17x17 Westinghouse, and 14x14 Combustion Engineering type assembly designs. Some general characteristics of the B&W critical experiments are listed below:

- Uranium Enrichment: 2.5 wt% – 4.0 wt%
- Cell Pitch: 1.64 cm
- Absorbers: Pyrex™, B_4C, Silver-Indium-Cadmium, Gadolinia (4.00 wt% Gd_2O_3)
- Temperature: ~21 °C (70 °F)

6.2.1.2 *KRITZ*

The KRITZ research reactor was operated by Studsvik during the 1970's. The reactor contains a square vessel which allows for the testing of many types of LWR fuel configurations. These experiments were performed at temperatures up to 243 °C (~470°F).

In 1973, Studsvik performed for Siemens KWU a comprehensive series of critical experiments in the KRITZ reactor. The pin enrichments, dimensions, and materials, as well as the pin pitch were those of 14x14 fuel assemblies designed for the German

reactor at Obrigheim. Guide tubes were inserted in the central 14X14 pin rows in number and at positions of the real fuel assemblies. Outside the simulated central assembly, waterholes were placed instead of guide tubes at the corresponding positions. Some general characteristics of the KRITZ critical experiments are listed below:

[ ]

6.2.1.3 *EPICURE*

The EPICURE experiments were performed by the CEA in the early 1990's in order to provide a validation base for spectral codes for the use of UO_2 and MOX fuel. The experiments were performed in CEA's EOLE experimental core at Cadarache. In support of the validation of APOLLO2-A, the experimental cores that contained only UO_2 fuel were analyzed. This includes the so-called UH1.2 experiments, which were used to simulate voided conditions with an aluminum over-cladding, and the UH1.4 experiments which were used to measure the effect of different absorber materials. Some general characteristics of the EPICURE critical experiments are listed below:

[ ]

6.2.1.4 *CAMELEON*

The CAMELEON experiments were also performed by the CEA in the 1980's in order to provide a validation base for spectral codes for the use of UO_2 fuel with several absorbers, including gadolinia. These experiments were also performed in CEA's EOLE experimental core at Cadarache. They included several different absorber configurations with and without guide tube locations. Some general characteristics of the CAMELEON critical experiments are listed below:

[ ]

6.2.2 Measurement Comparisons

Comparisons to measurements are presented for the reactivity and the fission rate distributions as calculated by APOLLO2-A. Some of the configurations do not provide measured data for the fission rate distributions.

6.2.2.1 *Reactivity*

The measured k_{-eff} for each of the critical experiments is considered to be 1.000 since the experiments are "critical"; however, the configurations performed by the CEA (EPICURE and CAMELEON) were not at an exactly critical state when the boron measurements were performed. A residual reactivity was provided in the documentation which accounts for this difference; therefore, for these experiments, the calculated values were compared to the "target k_{-eff}", which includes the excess reactivity provided in the experimental documentation. Tables 6.2-1 – 6.2-5 provide the results for each of the analyzed experiments with the calculated-to-measured (C-M) difference expressed in pcm, computed as (C-M) x 10^5.

Table 6.2-1: B&W-1970s Critical Experiment - Reactivity Comparisons

[ ]

Table 6.2-2: B&W-1980s Critical Experiment - Reactivity Comparisons

[ ]

Table 6.2-3: KRITZ KWU Critical Experiment - Reactivity Comparisons

[ ]

Table 6.2-4: EPICURE Critical Experiment - Reactivity Comparisons

[ ]

Table 6.2-5: CAMELEON Critical Experiment - Reactivity Comparisons

[ ]

6.2.2.2 *Fission Rate Distributions*

Fission rate measurements were not provided for all of the critical experiment configurations; therefore, comparisons of calculated to measured fission rate distributions were performed when possible. These results contain fuel pins with a wide range of relative pin power levels. Tables 6.2-6 – 6.2-10 provide the results for each of the configurations where comparisons were performed. The results shown are the RMS of the relative pin fission rate differences expressed in percent.

Table 6.2-6: B&W-1970s Fission Rate Distribution Comparisons

[ ]

Table 6.2-7: B&W-1980s Fission Rate Distribution Comparisons

[ ]

Table 6.2-8: KRITZ Fission Rate Distribution Comparisons

[ ]

Table 6.2-9: EPICURE Fission Rate Distribution Comparisons

[ ]

Table 6.2-10: CAMELEON Fission Rate Distribution Comparisons

[ ]

6.2.3 Discussion of Results – Critical Experiments

The above results show good agreement of the calculations with the measurements. For the results related to criticality, APOLLO2-A overestimated the $k_{\text{-eff}}$ of the analyzed experiments by an average of **[ ]** pcm with a standard deviation of **[ ]** pcm. Only **[ ]** analyzed configurations showed more than **[ ]** pcm of discrepancy with the measurements. The fission rate distributions also showed good agreement with the measurements. None of the experiments showed a discrepancy of more than **[ ]** RMS.

Furthermore, the data in the above results are well behaved for criticality and fission rate distributions on account of temperature, boron concentration, and absorber materials. In all, these results confirm the ability of APOLLO2-A to accurately calculate the reactivity and fission rate distribution of fuel pin lattices.

6.3 *Integral Experiments*

This sub-section presents the benchmarking of APOLLO2-A against integral experiments which are critical experiments composed of homogeneous pin arrays, and thus possible to model by a single cell representation of the core. For this representation, it is necessary to include in the models not only the axial buckling

measured during the experiments as in the critical experiments presented in sub-section 6.2, but also the radial buckling to take into account the radial leakage.

All of these critical experiments are UO_2 fueled experimental cores. These experiments allow a wider range of validation, in terms of U235 enrichment and moderator/fuel ratios (volume of fuel/volume of moderator), compared to the critical experiments presented in sub-section 6.2.

[ ]

6.3.1 Description of the Experimental Configurations: VALDUC

The VALDUC experiments were performed by the CEA and Institut de Protection et de Sûreté Nucléaire, now the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) in 1978 at CEA's experimental criticality facility located at Valduc, France. These experiments are part of the International Criticality Safety Benchmark Evaluation Project (ICSBEP). Some general characteristics of the VALDUC Critical Experiments are listed below:

[ ]

6.3.2 Measurement Comparisons: Reactivity

Comparisons to measurements are presented for the reactivity as calculated by APOLLO2-A. The measured reactivity for each of the critical experiments is considered to be 1.00000 since the experiments are "critical". Table 6.3-1 provides the results for each of the analyzed experiments with the C-M difference listed in pcm. Four different configurations were computed, namely 1662, 1659, 1555 and 1825.

Table 6.3-1: Single Cell Representation of Valduc Critical Experiments Reactivity Comparisons

[ ]

6.3.3 *Discussion of Results*

The above results show good agreement of the calculations with the measurements. APOLLO2-A overestimated the k_{-eff} of the analyzed experiments by an average of **[ ]** pcm with a standard deviation of **[ ]** pcm. These results demonstrate the ability of APOLLO2-A to accurately calculate the reactivity of UO_2 fueled lattices even with high moderation ratios.

6.4 *Spent Fuel Analyses*

This sub-section presents the benchmarking of APOLLO2-A against the fuel isotopic evolution during irradiation in a reactor core. For several irradiated fuel samples, comparisons of the measured isotopic composition and the composition calculated by APOLLO2-A are presented.

The samples come from several different power plants in France and Switzerland. They cover a large range of fuel types, including UO_2, Enriched Recycled Uranium (ERU), UO_2-Gd_2O_3 and MOX, as well as a large range of burnups, from 3 to 71 GWd/t. MOX samples are integrated into the APOLLO2-A validation base to support high burnup UO_2 fuel applications.

The calculations involving UO_2, ERU and UO_2-Gd_2O_3 were performed with single-assembly calculations. The calculations involving MOX were performed using the color-

set functionality of the code, in order to account for the environment of the MOX assembly.

A calibration is performed such that the final calculated burnup matches the final measured pin burnup, which is estimated by the concentration of a stable fission product. Nd-148 is used as a calibration isotope since it does not have a large neutron absorption cross-section and is therefore considered only produced by fission (or decay of fission produced short half-life parent nuclides).

6.4.1 Description of the Experiments

Several irradiated fuel experiments were computed for the validation process, for UO_2, ERU, UO_2-Gd_2O_3 and MOX fuel.

6.4.1.1 *Description of the Experiments on UO_2 Samples*

6.4.1.1.1 Bugey

This experimental program was performed in Bugey 3 power plant (900 MW_e) in France between 1978 and 1981. One sample was contained in a 17x17 assembly with Inconel grids, containing 3.1 wt% enriched fuel, and was irradiated for 1.5 cycles.

6.4.1.1.2 Gravelines

This experimental program was performed in Gravelines 2 and Gravelines 3 power plants (900 MW_e) also in France, between 1983 and 1989. The samples were contained in 17x17 assemblies with Zircalloy grids, containing 4.5 wt% enriched fuel, and were irradiated between 2 and 5 cycles. Seven samples were calculated with APOLLO2-A and compared to the measured data.

6.4.1.1.3 Malibu

This experimental program was performed in Gösgen power plant (1000 MW_e) in Switzerland between 1997 and 2001. It focused on high burnup fuel. The samples were contained in a 15x15 assembly, containing 4.3 wt% enriched fuel, and were

irradiated for 4 cycles. One sample was calculated with APOLLO2-A and compared to the measured data.

The chemical analysis of the sample was performed by three laboratories: the CEA in France, the Paul Scherrer Institut (PSI) in Switzerland and the Studiecentrum Voor Kernenergie – Centre d'Étude de l'Énergie Nucléaire (SCK-CEN) in Belgium.

6.4.1.2 *Description of the experiments on ERU samples*

6.4.1.2.1 Cruas

This experimental program was performed in Cruas 4 power plant (900 MW_e) in France between 1987 and 1990. The samples were contained in 17x17 assemblies with Inconel grids, containing ERU fuel with 3.1 wt% U235 and 1.2 wt% U236, and were irradiated between one and three cycles. Six samples were calculated with APOLLO2-A and compared to the measured data.

6.4.1.3 *Description of the experiments on UO_2-Gd_2O_3 samples*

6.4.1.3.1 Gedeon 1

This program was performed in the Melusine experimental core (8 MW) in Grenoble France between 1982 and 1984, and focused on the irradiation of UO_2-Gd_2O_3 fuel pins. The pins contained 5 wt% of Gd_2O_3 and were enriched to 3.25 wt% U235. Six different samples at six burnups were calculated with APOLLO2-A and compared to the measured data.

6.4.1.3.2 Gedeon 2

Like Gedeon 1, this program was performed in the Melusine experimental core (8 MW) in Grenoble between 1985 and 1988, also focusing on the irradiation of UO_2-Gd_2O_3 fuel pins. These pins contained 8 wt% of Gd_2O_3 and uranium enriched to 0.2 wt% of U235. Twelve samples at six different burnups were calculated with APOLLO2-A and compared to the measured data.

6.4.1.4 *Description of the experiments on MOX samples*

6.4.1.4.1 Saint Laurent

This experimental program was performed in Saint Laurent B1 power plant (900 MW_e) in France, between 1987 and 1991, and focused on MOX fuel. The samples were contained in 17x17 assemblies with Zircaloy grids, containing MOX with a Pu content between 2.9 and 5.6 wt% and, were irradiated for 2 or 3 cycles. Seven samples were calculated with APOLLO2-A and compared to the measured data.

6.4.1.4.2 Dampierre

This experimental program was performed in Dampierre 2 power plant (900 MW_e) in France, between 1993 and 2000. The samples were contained in 17x17 assemblies with Zircaloy grids, containing MOX with 6.7 wt% Pu content, that were irradiated for 4 or 5 cycles. Four samples were calculated with APOLLO2-A and compared to the measured data.

6.4.1.4.3 Malibu

This experimental program was performed in Gösgen power plant (1000 MW_e) in Switzerland, between 1997 and 2001. It focused on high burnup fuel. One sample was calculated with APOLLO2-A and compared to the measured data. The sample was contained in a 15x15 assembly, containing 8.1 wt% Pu, which was irradiated for 4 cycles. The chemical analysis of this sample was performed by three laboratories: the CEA, PSI, and the SCK-CEN, which also analyzed the UO_2 samples irradiated in Gösgen.

6.4.2 Measurement Comparisons

To simplify the presentation, comparisons of the calculations to the measurements are averaged by fuel type and burnup range since an explicit representation of every isotope at every measured burnup for every experiment would be overly cumbersome. Results are presented in the following sub-sections.

6.4.2.1 *Measurement Comparisons for UO_2 samples*

For UO_2 fuel, the results are averaged over 4 burnup ranges:

- A first range composed of 2 pins from Gravelines experiment and 1 pin from the Bugey experiment (average burnup of the 3 pins: 25 GWd/t)
- A second range composed of 2 pins from the Gravelines experiment (average burnup of the 2 pins: 44 GWd/t)
- A third range composed of 3 pins from the Gravelines experiment (average burnup of these 3 pins: 60 GWd/t)
- A fourth range composed of 1 pin from the Malibu experiment (burnup of the pin: 71 GWd/t)

The averaged results are presented in Table 6.4-1 for the main isotopes (C/M-1 in %).

Table 6.4-1: Isotopic Burnup Analysis – UO_2 Concentrations Comparisons (C/M-1)x100%

6.4.2.2 *Measurement Comparisons for ERU samples*

For ERU fuel, the results are averaged over 3 burnup ranges:

- A first range composed of 2 pins from the Cruas experiment (average burnup of the 2 pins: 14 GWd/t)
- A second range composed of 2 pins from the Cruas experiment (average burnup of the 2 pins: 22 GWd/t)
- A third composed of 2 pins from the Cruas experiment (average burnup of these 2 pins: 35 GWd/t)

The averaged results are presented Table 6.4-2 for the main isotopes (C/M-1 in %).

Table 6.4-2: Isotopic Burnup Analysis – ERU Concentrations Comparisons (C/M-1)x100%

[ ]

6.4.2.3 *Measurement Comparisons for UO_2-Gd_2O_3 samples*

For UO_2-Gd_2O_3 fuel, the results were averaged over 3 burnup ranges:

- A first range composed of the lower burnups of Gedeon 1 and Gedeon 2 experiments (average burnup of the 6 pins: 3 GWd/t)
- A second range composed of the intermediate burnups of Gedeon 1 and Gedeon 2 experiments (average burnup of the 8 pins: 7 GWd/t)
- A third range composed of the higher burnups of Gedeon 2 experiment (average burnup of the 4 pins: 11 GWd/t)

For pins containing Gd_2O_3, higher burnup measurements are of no interest since, after approximately 15 GWd/t, the gadolinia has burned out and then they resemble a UO_2 pin. The averaged results are presented in Table 6.4-3. These results are presented as a difference of the calculated and measured percentage of gadolinium isotope in the total gadolinium present (C-M)x100.

Table 6.4-3: Isotopic Burnup Analysis – UO_2-Gd_2O_3 Concentrations Comparisons (C-M)x100

[ ]

6.4.2.4 *Measurement Comparisons for MOX samples*

For MOX fuel, the results were averaged over 5 burnup ranges:

- A first range composed of 3 pins from the Saint Laurent experiment (average burnup of the 3 pins: 28 GWd/t)
- A second range composed of 4 from the Saint Laurent experiment (average burnup of the 4 pins: 42 GWd/t)
- A third range composed of 2 pins from the Dampierre experiment (average burnup of the 2 pins: 52 GWd/t)
- A fourth range composed of 2 pins from the Dampierre experiment (average burnup of the 2 pins: 57 GWd/t)

- A fifth range composed of one pin from the Malibu experiment (burnup of the pin: 68 GWd/t)

The averaged results are presented in the in Table 6.4-4 for the main isotopes (C/M-1 in %).

Table 6.4-4: Isotopic Burnup Analysis – MOX Concentrations Comparisons (C/M-1)x100%

[ ]

6.4.3 Isotopic Burnup Analysis Discussion of Results

The results presented for UO_2, ERU, UO_2-Gd_2O_3 and MOX show good agreement between the calculations and the measurements. This agreement demonstrates the ability of APOLLO2-A to accurately calculate the evolution of isotopic concentrations over a large range of burnup. The comparisons to measurements for Pu238 show some larger differences, but this isotope is present only in low concentration and has no significant impact on the reactivity.

[1] Not available: the measurements for the U-234 in the Dampierre experiment cannot be relied upon because the initial concentration of U-234 in the MOX samples was not precisely characterized; therefore, the results presented in the table for U-234 do not include this experiment.

6.5 *References*

6.5-1 "Physics Verification Program, Part III, Task 4", BAW-3647-20, March 1971

6.5-2 "Urania Gadolinia: Nuclear Model Development and Critical Experiment Benchmark", BAW-1810, April 1984

7.0 REFLECTOR TREATMENT

7.1 *Introduction*

In the 3D nuclear design calculations with ARTEMIS, the reflector is explicitly modeled. The cross-sections for the reflector are generated with the Equivalent Reflector Model 1 (ERM_1). The ERM_1 model uses 1D spectral slab calculations for generating the 2-group equivalent homogenized reflector constants. These equivalent cross-sections conserve the reflection response R^{het} of geometrically detailed transport theory reference solutions at the core/reflector interface in nodal diffusion theory calculations. Reflector cross-sections generated with the ERM_1 model depend only on the reflector layout and are widely independent of a specific reactor core layout or shuffle pattern. The same principles are applied for the conventional shroud/water reflector (also known as baffle/water reflector), the heavy reflector, and the axial reflector types.

The principles of the equivalent reflector model were already used with the SAV95 code system (see Reference 7.4-1).

7.2 *Reflector Physics*

The reflector of a conventional PWR consists of a steel shroud (thickness ≈ 2-3 cm) enclosing the core, followed by a relatively thick water layer as shown in Figure 7.2-1. A core equipped with a heavy reflector consisting of a massive steel construction with varying thickness of 10 to 20 cm **[**

] which is surrounded by a thin water region followed by the core barrel is shown in Figure 7.2-2.

For a shroud/water reflector with a thin steel shroud, fast neutrons are, to a greater extent, able to pass through the shroud. In the water region, these neutrons are thermalized. Some of the thermal neutrons are scattered back toward the core and can be absorbed by the thermally absorbing nuclides in the steel baffle (e.g., nickel).

In the heavy reflector, [

] the water outside the reflector is separated from the core by a thick steel layer. Compared to the shroud/water reflector, neutrons that enter the steel region are to a much smaller extent thermalized and [ ] in the water outside the reflector. In the case of the heavy reflector with its greater mass of steel, fast neutrons are reflected back into the core. Additionally, the fast flux is an order of magnitude higher than the thermal flux. This means a larger number of (fast) neutrons are re-entering the core where they contribute to fission. The effect is a reduction in leakage and a flattened power density distribution.

7.3 *Generation of Reflector Cross-Sections*

7.3.1 Theory

The ERM_1 model conserves the heterogeneous reflection response R^{het} at the radial and axial core/reflector interfaces. For that purpose, the specific reflector geometry is transformed into 1D slab representations of the fuel assembly/reflector geometry as shown in Figure 7.3-1. The flux solutions for these 1D transport eigenvalue problems are generated with APOLLO2-A (see sub-section 2.10), and provide the heterogeneous reflection response matrix at the core/reflector interface (equation (7-1)). [

]

[

] From these calculations follow two

sets $m = 1, 2$ of surface fluxes Φ_g^m and net currents J_g^m (g = energy group index) with the 2x2 response matrix R^{het} at the fuel/reflector interface as coefficients:

$$\Phi^{het} = \begin{pmatrix} \Phi_1^1 & \Phi_1^2 \\ \Phi_2^1 & \Phi_2^2 \end{pmatrix}^{het} = \begin{pmatrix} R_{11}^{het} & R_{12}^{het} \\ R_{21}^{het} & R_{22}^{het} \end{pmatrix} \begin{pmatrix} J_1^1 & J_1^2 \\ J_2^1 & J_2^2 \end{pmatrix}^{het} = R^{het} J^{het} \quad (7\text{-}1)$$

The conservation of the 1D two-group reflection response with equivalent homogenized cross-sections:

$$R^{het} = \Phi^{het} \cdot \left(J^{het}\right)^{-1} = \Phi^{\hom} \cdot \left(J^{\hom}\right)^{-1} = R^{\hom} \quad (7\text{-}2)$$

leads to four non-linear equations for the unknown diffusion coefficients D_g and the heterogeneity factors HF_g. [

]

[ ] (7-3)

with

Σ_c	macroscopic capture cross-section
Σ_t	macroscopic transport cross-section
D	diffusion coefficient
$\Sigma_{1\rightarrow 2}$	macroscopic slowing down cross-section

[ ]

[ ] (7-4)

[
]

For conventional shroud/water reflectors, a geometrical correction (see equation (7-5)) is applied for re-entrant corners of the reflector to account for the higher volume ratio of shroud and the reduced amount of moderator in these nodes:

[ ] (7-5)

[
]

For heavy reflectors, the generation of cross-sections with 1D slab geometries results in nodal reactor calculations with an in/out shift of the radial fission rate distribution when compared to reference solutions. [

]

The cross-sections for the heavy reflector depend on the following parameters in order to capture spectral effects:

[ ]

The top and bottom reflectors are generated in the same manner as the radial reflectors and the technique is identical for all PWR reactor types.

7.3.2 *Qualification of the ARTEMIS Reflector Model*

7.3.2.1 *MCNP Model*

Calculations with the Monte Carlo code MCNP5 are the reference for the qualification of the reflector model. The nuclear data used for the reference reactor calculations is a continuous energy JEFF3.1.1 master library. The MCNP model is set up as 2D reactor core in octant symmetry with a detailed geometric representation of the fuel assemblies and the radial reflector, see Figures 7.2-1 and 7.2-2. The MCNP inputs for the fuel assemblies are consistently derived from the APOLLO2-A inputs used to generate the ARTEMIS cross-section libraries.

The MCNP calculations have been performed such that the statistical errors for fuel assembly average fission rates are below 1% and the statistical error of the eigenvalue is < 100 pcm in each case.

7.3.2.2 *Comparison of ARTEMIS with MCNP Calculations*

No measured data are available for reactors with a heavy reflector and comparisons with reference calculations are required for verification of the ARTEMIS equivalent reflector model. The qualification of the reflector model includes comparisons for a conventional shroud/water reflector and the heavy reflector for estimation of the achievable accuracy.

The qualification of ERM_1 is performed by comparing the 2D MCNP results to equivalent 2-group 2D ARTEMIS reactor calculations. The general applicability of the reflector constants is demonstrated for different core loadings with moderator temperature variations in the range $293 \le T_m \le 573$ °K as well as for boron concentrations ranging from $0 \le c_B \le 1500$ ppm B_{nat}. The reactor calculations are performed for a conventional shroud/water as well as for the heavy reflector.

Figure 7.3-3 summarizes the results of the comparisons for all cases. The cases highlighted in grey indicate heavy reflector applications. The evaluation shows that

there is no difference in the quality of results between applications with the conventional and the heavy reflector. This is confirmed by the exemplary comparisons of fuel assembly average fission rate/power density distributions shown in Figure 7.3-4 for the conventional reflector and in Figure 7.3-5 for the heavy reflector. No in/out or azimuthal trends of the error distribution can be identified.

The comparisons for varying moderator temperature (and density) as well as boron concentration that are shown in Figure 7.3-3 verify the general applicability of the ERM_1 model for reflector cross-section generation. Cases 25 and 26 demonstrate the independence of the results from the core loading pattern.

7.4 *References*

7.4-1 “Reactor Analysis System for PWRs,” EMF-96-029(P)(A), Volumes 1 and 2

Figure 7.2-1: Typical Layout of the Reflector in a Conventional PWR

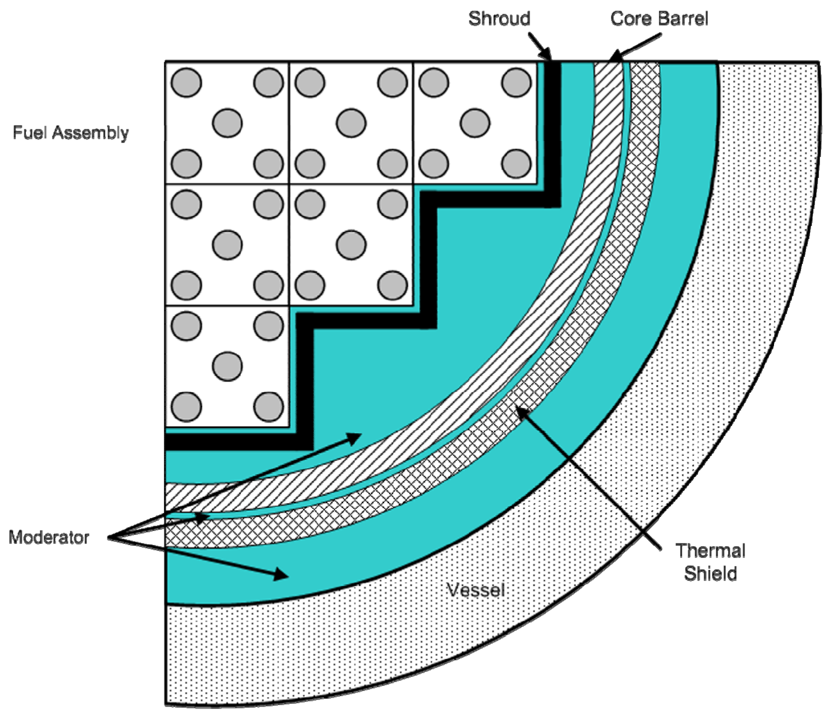


Figure 7.2-2: Typical Layout of the Heavy Reflector in a PWR

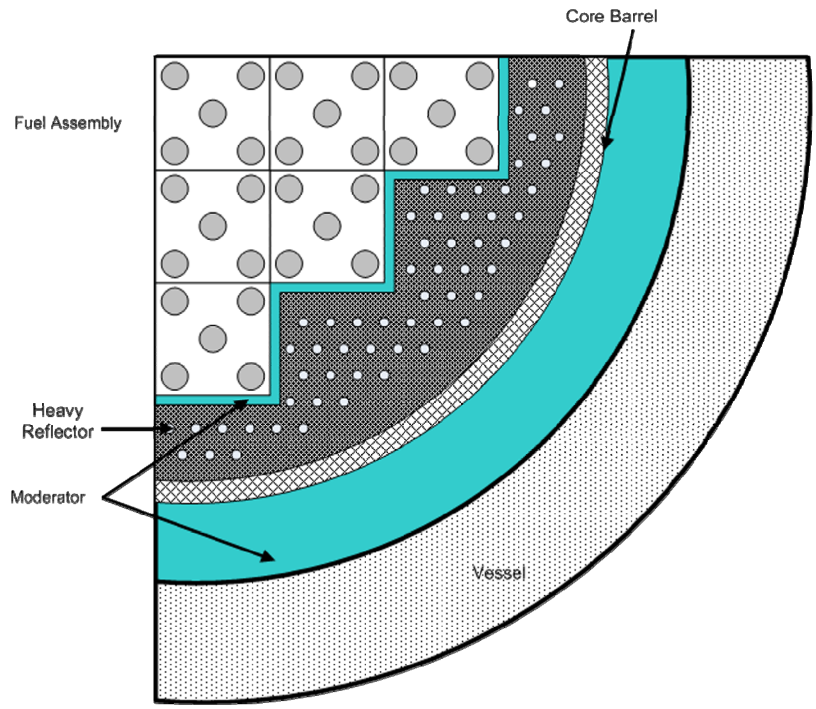


Figure 7.3-1: 1D Reflector Model for Spectral Calculation

(Example: Shroud/Water Reflector)

Figure 7.3-2: Heavy Reflector Geometry

Figure 7.3-3: Comparisons of the Differences of the Normalized Fuel Assembly Average Power Densities between MCNP and ARTEMIS for Conventional and Heavy Reflector

Figure 7.3-4: Typical Differences of the Power Density Distribution between MCNP and ARTEMIS for the Conventional Reflector

(Case Index 10: Boron Concentration 500 ppm B_{nat}, Moderator Temperature 573 K, Fuel Temperature 900 K, no Xenon)

Figure 7.3-5: Typical Differences of the Power Density Distributions between MCNP and ARTEMIS for the Heavy Reflector

(Case Index 3: Boron Concentration 500 ppm B_{nat}, Moderator Temperature 573 K, Fuel Temperature 900 K, no Xenon)

8.0 ARTEMIS VERIFICATION FOR THERMAL-HYDRAULIC MODULE

8.1 *Introduction*

This chapter documents the verification of the thermal-hydraulic module COBRA-FLX in ARTEMIS. The verification and validation of COBRA-FLX as a Core Thermal-Hydraulic Analysis Code is documented in Topical Report (Reference 8.3-1), and therefore will not be addressed in this chapter. Calculations performed with COBRA-FLX external to ARTEMIS are referred to as stand-alone COBRA-FLX calculations. Implementation of COBRA-FLX as a module within ARTEMIS and the stand-alone version of the COBRA-FLX code are based on identical source code. The difference is in the data flow to the COBRA-FLX module. For the ARTEMIS coupled calculations, data is exchanged directly with the neutronics and the fuel rod modules. The stand-alone COBRA-FLX calculations receive the required data from external files. The verification of the COBRA-FLX module is based upon comparisons to the stand-alone COBRA-FLX code and comparisons of ARTEMIS using the COBRA-FLX module to measured results (see sub-section 8.2).

8.2 *Comparison of COBRA-FLX Module in ARTEMIS with the Stand-Alone COBRA-FLX*

This verification demonstrates that the coupling in ARTEMIS between the thermal-hydraulic module (COBRA-FLX), the neutronics module and the fuel rod module is correct. For an arbitrarily chosen calculation point at 100% power in a typical PWR, the nodal powers generated by the coupled system within ARTEMIS are written on an external data file. This data is input as a boundary condition to the stand-alone COBRA-FLX calculation. This stand-alone COBRA-FLX calculation uses the same thermal-hydraulic and geometric data as the coupled case. This kind of test is done for two cases; one with the same axial spacing in all modules and one with different axial spacing in the modules. The resulting 3D water densities from the coupled system calculation and from the stand-alone thermal-hydraulic calculation are compared in Table 8.2-1. Differences are very small, having a standard deviation of approximately

3.4E-5 kg/m^3, which is insignificant, being within the accuracy of the data written to the power distribution file.

Calculations documented in this chapter confirm that the use of the COBRA-FLX module for the calculation of thermal-hydraulic properties is correctly implemented in ARTEMIS.

Table 8.2-1: Water Density Distribution Comparisons Between the Coupled and the Stand Alone COBRA-FLX. (Absolute Values in kg/m^3 are Documented)

Test	Min Relative Difference	Max Relative Difference	Std Dev of Relative Difference
Different axial nodalization	-3.72E-5	1.49E-4	3.31E-5
Same axial nodalization	-3.67E-5	1.63E-4	3.41E-5

8.3 *References*

8.3-1. COBRA-FLX: Core Thermal-Hydraulic Analysis Code ANP-10311, Rev. 0

9.0 VERIFICATION OF THE FUEL ROD MODULE

9.1 *Verification with Analytical Results*

9.1.1 Principle

Verification of the FRM consists of comparing the FRM output to analytical solutions of various cases, covering steady state and transient applications. The checked parameters are:

- The temperature rise between outer and inner surfaces (centerline for solid pellet): $\Delta T \equiv T_{in} - T_{out}$.
- The outer heat flux $\Phi_{out} \equiv \Phi(r_{out})$ that should always be equal to $\frac{P_l}{2\pi r_{out}}$ in steady-state.

9.1.2 Case description & results

Case Description	ΔT error: |ΔT$_{FRM}$/ΔT$_{A}$-1| *100%	Φ_{out} error: | $\Phi_{out\,FRM}$/ $\Phi_{out\,A}$-1| *100%
STEADY STATE		
Solid cylinder with 1 material with constant properties and a uniform radial power distribution: Boundary conditions for both solutions: Single fuel material from a null inner radius to an outer radius; homogeneous conductivity without temperature dependency; uniform radial power distribution; 10 equidistant rings; external temperature (Dirichlet boundary condition).	0. %	0. %
Hollow cylinder (annular pellet) with 1 material and a uniform radial power distribution:	0.02 %	0. %

Case Description	ΔT **error:** **|ΔTFRM/ΔTA-1| *100%**	Φ_{out} **error:** **|$\Phi_{out\ FRM}/\Phi_{out\ A}$-1| *100%**
Boundary conditions for both solutions: Single fuel material with an inner/outer radius ratio of 30%; homogeneous conductivity without temperature dependency; uniform radial power distribution; 10 equidistant rings; external temperature.		
Solid cylinder with 1 material with constant properties and a parabolic radial power distribution: Boundary conditions for both solutions: Single fuel material from a null inner radius to an outer radius; homogeneous conductivity without temperature dependency; parabolic radial power distribution: $p(x) = \frac{2}{\pi(1+\alpha)}\left[1+(\alpha-1)x^2\right]$ with $\alpha = 1.5$; 10 equidistant rings; external temperature.	0.04 %	0. %
Solid cylinder with 1 material with constant properties and a two-step radial power distribution: Boundary conditions for both solutions: Single fuel material from a null inner radius to an outer radius; homogeneous conductivity without temperature dependency; 2-step radial power distribution: $p(x) = w \cdot \frac{1}{\pi} + (1-w) \cdot \frac{\theta(x-s)}{\pi(1-s^2)}$ with $\alpha = 1.5$, $s = 0.8$, $w = 0.85$; 10 equidistant rings; external temperature.	0.24 %	0. %
Solid cylinder with 1 material with temperature dependent properties, a parabolic radial power distribution: Boundary conditions for both solutions: Single fuel material from a null inner radius to an outer radius; parabolic conductivity with respect to the	0.1 %	0. %

Case Description	ΔT error: $\lvert\Delta T_{FRM}/\Delta T_A - 1\rvert$ *100%	Φ_{out} error: $\lvert\Phi_{out\,FRM}/\Phi_{out\,A} - 1\rvert$ *100%
temperature: $\lambda(T) = a_2T^2 + a_1T + a_0$ with: • $a_2 = 1.10125\text{x}10^{-8}$ W/cm/°C^3 • $a_1 = -4.1483\text{x}10^{-5}$ W/cm/°C^2 • $a_0 = 6.1832\text{x}10^{-2}$ W/cm/°C parabolic radial power distribution: $p(x) = \frac{2}{\pi(1+\alpha)}\left[1+(\alpha-1)x^2\right]$ with $\alpha = 1.5$; 10 equidistant rings; external temperature.		
Fuel-Gap-Clad with temperature dependent properties, a parabolic radial power distribution: Boundary conditions for both solutions: Three media: fuel (UO_2), gap (Helium) and clad (Zircaloy); temperature-dependant thermal conductivity : parabolic conductivity in the fuel, constant conductivity in the gap; linear conductivity in the clad; parabolic radial power distribution; 10 equidistant rings; external clad temperature.	0.44 %	0. %
Fuel-Gap-Clad with temperature dependent properties, a parabolic radial power distribution, gap modeled via a resistance: Boundary conditions for both solutions: The heat equation is solved under the same conditions as above except the following: gap modeled by a contact resistance, the conductivity of the gap being replaced by a fixed conductance h_{gap} .	0.44 %	0. %
Solid cylinder with 1 material, a uniform radial power distribution and an outer conductance:	0. %	0. %

Case Description	ΔT error: $\lvert \Delta T_{FRM}/\Delta T_{A}-1 \rvert$ *100%	Φ_{out} error: $\lvert \Phi_{out\,FRM}/\Phi_{out\,A}-1 \rvert$ *100%
Boundary conditions for both solutions: Single fuel material from a null inner radius to an outer radius; homogeneous conductivity without temperature dependency; uniform radial power distribution; outer conductance H_{out} and outer temperature T_{out} as fixed fluid conditions.		
TRANSIENT		
Solid cylinder with 1 material, a uniform radial power distribution and a step transition to zero power: Boundary conditions for both solutions: One medium: fuel (UO_2); fixed conductivity, specific heat and density; uniform radial power distribution in the fuel; external temperature fixed over time; At t=0: stationary solution; at t>0: the linear heat rate is zeroed.	0.7 % at the maximum absolute temperature discrepancy amounting 0.95°C	1.4% discrepancy when $\Phi_{out}(t)$ reaches 10% of $\Phi_{out}(t=0)$ 3% discrepancy when $\Phi_{out}(t)$ reaches 1% of $\Phi_{out}(t=0)$
Solid cylinder with 1 material, a uniform radial power distribution and an oscillating linear heat rate and outer temperature: Boundary conditions for both solutions: One medium: fuel (UO_2); fixed conductivity, specific heat and density; uniform radial power distribution in the fuel; At t>0: $P_l\ (t) = P_l\ (0) + \Delta P \sin(\omega t)$ **AND** $T_{out}(t) = T_{out}(0) - \frac{\Delta P}{\omega} \frac{1}{C_P \rho \pi r_{out}^2} \left[\cos(\omega t) - 1\right]$	0. %	0. %
Solid cylinder with 1 material, a uniform radial	0.11 %	0.1 %

Case Description	ΔT **error:** **|ΔT$_{FRM}$/ΔT$_A$-1| *100%**	Φ_{out} **error:** **|Φ_{out} FRM/Φ_{out} A-1| *100%**
power distribution and a step change of power: Boundary conditions for both solutions: One medium: fuel (UO_2); fixed conductivity, specific heat and density; uniform radial power distribution in the fuel; external temperature fixed over time; At t>0 the linear heat rate is set to $P_l(t) = P_l(0) + \Delta P$.		
Solid cylinder with 1 material, a uniform radial power distribution and a constant increase of linear rate: Boundary conditions for both solutions: One medium: fuel (UO_2); fixed conductivity, specific heat and density; uniform radial power distribution in the fuel; external temperature fixed over time At t>0 the linear heat rate is set to $P_l(t) = P_l(0) \cdot (1 + bt)$	0.08 %	0.1 %
Solid cylinder with 1 material, a uniform radial power distribution and a step change of the outer conductance: Boundary conditions for both solutions: One medium: fuel (UO_2); fixed conductivity, specific heat and density; uniform radial power distribution in the fuel; At t>0 the linear heat rate remains stable $P_l(t) = P_l(0)$; the outer temperature remains stable: $T_{out}(t) = T_{out}(0)$; the outer conductance is modified: $H_{out}(t) = H_{out}(t > 0) = H_{out}(0) + \Delta H_{out}$	0.3 %	1.5 %

The results are thus satisfactory:

- The differences on temperature rise remain below 1%,

- The heat flux is more sensitive than the temperatures for transient situations far from a steady state equilibrium. Though, the differences remain below 1.5%, and are only reaching higher values for very low heat flux points simulating shutdown conditions.

9.2 *VALIDATION with Measured Results*

Validation of the Fuel Rod Module relies on the benchmarking results described in Chapters 10 and 11. The calculations shown in Chapter 9 are generated using coupled Neutronic/ Thermal-hydraulic / Thermomechanical / Fuel Rod modules and demonstrate the applicability of these modules for a variety of plant types using various fuel assembly types to measured results.

9.3 *Conclusions*

No major discrepancies have been noticed directly, on the standalone comparisons regarding cases with analytical solutions and indirectly, on the cases involving the coupled Neutronic / Thermal-hydraulic / Thermomechanical modules.

10.0 ARCADIA® BENCHMARKING RESULTS

10.1 *Introduction*

AREVA currently uses the SAV95 (MICBURN/CASMO/PRISM) code system, and the combination of CASMO-3/NEMO, Reference 10.6-1 and 10.6-3, respectively, which are NRC approved methodologies. It is the intention of AREVA to replace these code systems for core designs activities with ARCADIA®. The purpose of this chapter is to provide validation of the ARCADIA® system for core design calculations.

10.2 *Validation*

The AREVA Neutronics design package, ARCADIA®, consists of a cross-section generator code, APOLLO2-A, a reactor core simulator computer code ARTEMIS, and supporting data processing codes. Data calculated with ARCADIA® are compared to measured data in order to demonstrate the accuracy and capability of the code system. In the following sections are comparisons of data calculated with the ARCADIA® code system and measured data, startup physics test data, and core follow data obtained from several commercial PWRs. The validation criteria chosen for the ARCADIA® model is based on the ANSI/ANS-19.6.1 standard in Reference 10.6-2.

10.2.1 Validation with Commercial Reactor Measurements

The validation calculations performed with ARCADIA® involve comparisons with measurements obtained at commercial reactors. Each plant in the sample has an associated plant type specification and fuel type specification.

The 'plant type' specification refers to the NSSS vendor and the total number of fuel assemblies in the core, examples of ‘plant types’ specified include:

- Westinghouse reactor containing 157 assemblies
- Westinghouse reactor containing 193 assemblies
- Babcock & Wilcox reactor containing 177 assemblies

- Siemens reactor containing 177 assemblies
- Siemens KONVOI reactor containing 193 assemblies
- Combustion Engineering reactor containing 217 assemblies

The 'fuel type' specification refers to the size of the rod array and the guide tube configuration in an assembly, examples of ‘fuel types’ include:

- 14x14 array with Combustion Engineering guide tube configuration
- 15x15 array with Siemens guide tube configuration
- 15x15 array with Babcock & Wilcox guide tube configuration
- 17x17 array with Westinghouse guide tube configuration
- 18x18 array with Siemens KONVOI guide tube configuration

A unique combination of a plant type and a fuel type will be referred to as a 'plant/fuel type'. Additional validation in this sub-section shows that the code system is capable of adequately modeling PWR cores. The ARCADIA® validation used the following plant/fuel types:

- Westinghouse 157 assembly, 17x17 array
- Westinghouse 193 assembly, 17x17 array
- Combustion Engineering 217 assembly, 14x14 array
- Siemens KONVOI 193 assembly, 18x18 array
- Siemens 177 assembly, 15x15 array
- Babcock & Wilcox 177 assembly, 15x15 array

For each sample plant, measured data from one or more cycles is compared with ARCADIA® predictions. A description of each plant and cycle used in the validation calculations is provided in order to illustrate the range of parameters included in the benchmarking. This description includes:

- Description of the fresh and burnt fuel assemblies, including:
  - Initial enrichments
  - Burnable poison loading

- Cycle length
- Any unique features of this plant/cycle

Nine plants, each with a unique plant/fuel type combination, are used in this validation against commercial reactor measurements. The plants are referred to as A, B, C, G1, G2, S1, S2, T1 and V1. The sample plants and corresponding cycle descriptions are provided below.

Plant A Cycles 1-14

Plant Type: Westinghouse reactor containing 157 assemblies

Fuel Type: 17x17 array with the Westinghouse guide tube configuration shown in Appendix A Figure A 10.2.1-1

Plant A Cycle 1

This cycle was loaded with 157 fresh fuel assemblies, including:

- 53 at 2.10 wt% U235,
- 52 at 2.60 wt% U235, and
- 52 at 3.10 wt% U235.

The fresh fuel contained 1040 discrete burnable absorber rods utilizing borosilicate glass, which were loaded in guide tube locations. All fuel was Westinghouse LOPAR design. Cycle 1 operated to approximately 15,285 MWd/mtU.

Plant A Cycle 2

This cycle design loaded 52 fresh assemblies, including:

- 36 at 3.60 wt% U235, and
- 16 at 3.99 wt% U235.

The burned fuel assemblies included:

- 105 once-burnt assemblies at 3.10, 2.60 and 2.10 wt% U235.

The fresh fuel contained 400 discrete wet annular burnable absorber rods utilizing B_4C pellets, which were loaded in guide tube locations. All fuel was Westinghouse LOPAR design. Cycle 2 operated to approximately 12,593 MWd/mtU.

Plant A Cycle 3

This cycle design loaded 52 fresh assemblies, including:

- 24 at 4.00 wt% U235 and
- 28 at 4.40 wt% U235.

The burned fuel assemblies included:

- 53 once-burnt assemblies at 3.99, 3.60 and 2.10 wt% U235,
- 52 twice-burnt assemblies at 3.10 and 2.60 wt% U235.

The fresh fuel included 4144 fuel rods with boron-coated fuel pellets. This cycle was a mixed core of Westinghouse LOPAR and Vantage 5 designs. Cycle 3 operated to approximately 15,117 MWd/mtU.

Plant A Cycle 4

This cycle design loaded 60 fresh assemblies, including:

- 32 at 4.40 wt% U235 and
- 28 at 4.80 wt% U235.

The burned fuel assemblies included:

- 52 once-burnt assemblies at 4.40 and 4.00 wt% U235, and
- 45 twice-burnt assemblies at 3.99, 3.60, and 3.10 wt% U235.

The fresh fuel contained 176 discrete wet annular burnable absorber rods utilizing B_4C pellets, which were loaded in guide tube locations, and 5,504 fuel rods with boron-coated fuel pellets. This cycle was a mixed core of Westinghouse LOPAR and Vantage 5 designs. The cycle operated to approximately 18,034 MWd/mtU.

Plant A Cycle 5

This cycle design loaded 60 fresh assemblies, including:

- 32 at 4.40 wt% U235 and
- 28 at 4.80 wt% U235.

The burned fuel assemblies included:

- 64 once-burnt assemblies at 4.80, 4.40, and 2.10 wt% U235, and
- 33 twice-burnt assemblies at 4.40 and 4.00 wt% U235.

The fresh fuel contained 96 discrete wet annular burnable absorber rods utilizing B_4C pellets which were loaded in guide tube locations and 4,096 fuel rods with boron-coated fuel pellets. This cycle was a mixed core of Westinghouse LOPAR and Vantage 5 designs. Cycle 5 operated to approximately 19,198 MWd/mtU.

Plant A Cycle 6

This cycle design loaded:

- 52 fresh assemblies at 4.95 wt% U235.

The burned fuel assemblies included:

- 69 once-burnt assemblies at 4.80, 4.40, and 2.10 wt% U235, and
- 36 twice-burnt assemblies at 4.80 and 4.40 wt% U235.

The fresh fuel contained 832 gadolinia-bearing fuel rods in concentrations of 2, 6, and 8 wt% Gd_2O_3. This cycle was a mixed core of Westinghouse LOPAR, Westinghouse Vantage 5, and AREVA HTP designs. Cycle 6 operated to approximately 18,469 MWd/mtU.

Plant A Cycle 7

This cycle design loaded:

- 60 fresh fuel assemblies at 4.81 wt% U235.

The burned fuel assemblies included:

- 77 once-burnt assemblies at 4.95 and 2.10 wt% U235, and
- 20 twice-burnt assemblies at 4.80 wt% U235.

The fresh fuel contained 944 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. This cycle was a mixed core of Westinghouse LOPAR, Westinghouse Vantage 5, and AREVA HTP designs. Cycle 7 operated to approximately 19,051 MWd/mtU.

Plant A Cycle 8

This cycle design loaded 60 fresh fuel assemblies, including:

- 24 at 4.47 wt% U235 and
- 36 at 4.90 wt% U235.

The burned fuel assemblies included:

- 60 once-burnt assemblies at 4.81 wt% U235, and
- 37 twice-burnt assemblies at 4.95 and 3.10 wt% U235.

The fresh fuel contained 1168 gadolinia-bearing fuel rods in concentrations of 2, 6, and 8 wt% Gd_2O_3. This cycle included Westinghouse LOPAR and AREVA HTP designs. The cycle operated to approximately 18,847 MWd/mtU.

Plant A Cycle 9

This cycle design loaded 56 fresh fuel assemblies, including:

- 20 at 4.35 wt% U235 and
- 36 at 4.85 wt% U235.

The burned fuel assemblies included:

- 60 once-burnt assemblies at 4.90 and 4.47 wt% U235, and
- 41 twice-burnt assemblies at 4.81 and 3.10 wt% U235.

The fresh fuel contained 1088 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. This cycle was a mixed core of Westinghouse LOPAR and AREVA HTP designs. Cycle 9 operated to approximately 18,731 MWd/mtU.

Plant A Cycle 10

This cycle design loaded 60 fresh fuel assemblies, including:

- 32 at 4.25 wt% U235 and
- 28 at 4.75 wt% U235.

The burned fuel assemblies included:

- 61 once-burnt assemblies at 4.85, 4.35, and 2.10 wt% U235, and
- 36 twice-burnt assemblies at 4.90 wt% U235.

The fresh fuel contained 1136 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. This cycle was a mixed core of Westinghouse LOPAR and AREVA HTP designs. Cycle 10 operated to approximately 18,910 MWd/mtU.

Plant A Cycle 11

This cycle design loaded:

- 65 fresh fuel assemblies at 4.95 wt% U235.

The burned fuel assemblies included:

- 64 once-burnt assemblies at 4.85, 4.75 and 4.25 wt% U235, and
- 28 twice-burnt assemblies at 4.85 wt% U235.

The fresh fuel contained 1208 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. All fuel was AREVA HTP design. Cycle 11 operated to approximately 19,003 MWd/mtU.

Plant A Cycle 12

This cycle design loaded 64 fresh fuel assemblies, including:

- 36 at 4.35 wt% U235 and
- 28 at 4.85 wt% U235.

The burned fuel assemblies included:

- 65 once-burnt assemblies at 4.95 wt% U235 and
- 28 twice-burnt assemblies at 4.75 wt% U235.

The fresh fuel contained 1568 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. All fuel was AREVA HTP design. Cycle 12 operated to approximately 19,742 MWd/mtU.

Plant A Cycle 13

This cycle design loaded:

- 65 fresh fuel assemblies at 4.95 wt% U235.

The burned fuel assemblies included:

- 64 once-burnt assemblies at 4.85 and 4.35 wt% U235, and
- 28 twice-burnt assemblies at 4.95 wt% U235.

The fresh fuel contained 1588 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. All fuel was AREVA HTP design. Cycle 13 operated to approximately 20,246 MWd/mtU.

Plant A Cycle 14

This cycle design loaded 68 fresh fuel assemblies including:

- 36 at 4.25 wt% U235 and
- 32 at 4.75 wt% U235.

The burned fuel assemblies included:

- 61 once-burnt assemblies at 4.95 wt% U235, and

- 28 twice-burnt assemblies at 4.85 wt% U235.

The fresh fuel contained 1312 gadolinia-bearing fuel rods in concentrations of 4, 6, and 8 wt% Gd_2O_3. All fuel was AREVA HTP design. Cycle 14 operated to approximately 20,001 MWd/mtU.

Plant B Cycle 1

Plant Type: Westinghouse reactor containing 157 assemblies

Fuel Type: 17x17 array with the Westinghouse guide tube configuration shown in Appendix B Figure B 10.2.1-2.

<u>Plant B Cycle 1</u>

This cycle was loaded with 157 fresh fuel assemblies, including:

- 53 at 1.80 wt% U235,
- 52 at 2.40 wt% U235, and
- 52 at 3.10 wt% U235.

The fresh fuel contained 448 discrete burnable absorber rods utilizing borosilicate glass, which were loaded in guide tube locations, and 352 gadolinia-bearing fuel rods in a concentration of 8 wt% Gd_2O_3. Cycle 1 operated to approximately 14,808 MWd/mtU.

Plant C Cycles 10-18

Plant Type: Combustion Engineering reactor containing 217 assemblies

Fuel Type: 14x14 array with the Combustion Engineering guide tube configuration shown in Appendix C Figure C 10.2.1-3.

<u>Plant C Cycle 10</u>

This cycle contained:

- 60 fresh zone-loaded fuel assemblies at 3.45/ 3.00 wt% U235.

The burned fuel assemblies included:

- 20 once-burnt zone-loaded assemblies at 2.90/2.60 wt% U235,
- 48 once-burnt zone-loaded assemblies at 3.30/2.90 wt% U235,
- 4 twice-burnt assemblies at 2.73 wt% U235,
- 16 twice-burnt zone-loaded assemblies at 2.90/2.60 wt% U235,
- 48 twice-burnt zone-loaded assemblies at 3.30/2.90 wt% U235,
- 8 thrice-burnt zone-loaded assemblies at 3.29/2.91 wt% U235,

The re-insert fuel assemblies included:

- 1 once-burnt assembly at 3.20 wt% U235 discharged at EOC5,
- 3 once-burnt assemblies at 3.22 wt% U235 discharged at EOC6
- 1 twice-burnt assembly at 2.70 wt% U235 discharged at EOC6,
- 8 twice-burnt assemblies at 2.73 wt% U235 discharged at EOC7.

The fresh fuel contained 576 gadolinia-bearing fuel rods in concentrations of 1 and 6 wt% Gd_2O_3. Cycle 10 operated to approximately 13,036 MWd/mtU.

Plant C Cycle 11

This cycle contained:

- 72 fresh fuel zone-loaded assemblies at 4.12/3.59 wt% U235.

The burned fuel assemblies included:

- 60 once-burnt zone-loaded assemblies at 3.45/3.00 wt% U235,
- 12 twice-burnt zone-loaded assemblies at 2.90/2.60 wt% U235,
- 48 twice-burnt zone-loaded assemblies at 3.30/2.90 wt% U235,
- 1 twice-burnt assembly at 3.20 wt% U235,
- 3 twice-burnt assemblies at 3.22 wt% U235,
- 8 thrice-burnt zone-loaded assemblies at 3.30/2.90 wt% U235.

The re-insert fuel assemblies included:

- 2 once-burnt assemblies at 2.70 wt% U235 discharged at EOC5,
- 3 once-burnt assemblies at 3.20 wt% U235 discharged at EOC5,
- 2 once-burnt assemblies at 2.73 wt% U235 discharged at EOC6,

- 1 once-burnt assembly at 3.22 wt% U235 discharged at EOC6,
- 1 twice-burnt assembly at 3.20 wt% U235 discharged at EOC6,
- 2 twice-burnt assemblies at 2.70 wt% U235 discharged at EOC7,
- 2 twice-burnt assemblies at 2.73 wt% U235 discharged at EOC7.

The fresh fuel contained 792 gadolinia-bearing fuel rods in concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 11 operated to approximately 11,803 MWd/mtU.

Plant C Cycle 12

This cycle contained:

- 72 fresh zone-loaded fuel assemblies at 4.05/3.53 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt zone-loaded assemblies at 4.12/3.59 wt% U235,
- 60 twice-burnt zone-loaded assemblies at 3.45/3.00 wt% U235,
- 2 twice-burnt assemblies at 2.73 wt% U235,
- 2 twice-burnt assemblies at 2.70 wt% U235,
- 8 thrice-burnt zone-loaded assemblies at 3.30/2.90 wt% U235.

One re-insert fuel assembly was:

- 1 twice-burnt assembly at 2.70 wt% U235 discharged at EOC6.

The fresh fuel contained 800 gadolinia-bearing fuel rods in concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 12 operated to approximately 15,668 MWd/mtU.

Plant C Cycle 13

This cycle contained:

- 84 fresh zone-loaded fuel assemblies at 4.70/4.09 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt zone-loaded assemblies at 4.05/3.53 wt% U235
- 61 twice-burnt zone-loaded assemblies at 4.12/3.59 wt% U235.

The fresh fuel contained 1,008 gadolinia-bearing fuel rods in concentrations of 1, 2, 4, 6, and 8 wt% Gd_2O_3. Cycle 13 operated to approximately 15,766 MWd/mtU.

Plant C Cycle 14

This cycle contained:

- 72 fresh zone-loaded fuel assemblies at 4.30/3.74 wt% U235.

The burned fuel assemblies included:

- 84 once-burnt zone-loaded assemblies at 4.70/4.09 wt% U235
- 56 twice-burnt zone-loaded assemblies at 4.05/3.53 wt% U235

The re-insert fuel assemblies include:

- 5 twice-burnt zone-loaded assemblies at 4.12/3.59 wt% U235 discharged at EOC12.

The fresh fuel contained 848 gadolinia-bearing fuel rods in concentrations of 2 and 6 wt% Gd_2O_3. Cycle 14 operated to approximately 19,061 MWd/mtU.

Plant C Cycle 15

This cycle contained:

- 80 fresh zone-loaded fuel assemblies at 4.43/3.85 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt zone-loaded assemblies at 4.30/3.74 wt% U235
- 64 twice-burnt zone-loaded assemblies at 4.70/4.09 wt% U235

The re-insert fuel assembly was:

- 1 twice-burnt zone-loaded assembly at 4.12/3.59 wt% U235 discharged at EOC12.

The fresh fuel contained 816 gadolinia-bearing fuel rods in concentrations of 2, 4, and 8 wt% Gd_2O_3. Cycle 15 operated to approximately 16,104 MWd/mtU.

Plant C Cycle 16

This cycle contained:

- 68 fresh zone-loaded fuel assemblies at 4.40/3.83 wt% U235.

The burned fuel assemblies included:

- 80 once-burnt zone-loaded assemblies at 4.43/3.85 wt% U235
- 68 twice-burnt zone-loaded assemblies at 4.30/3.74 wt% U235

The re-insert fuel assembly was:

- 1 twice-burnt zone-loaded assembly at 4.12/3.59 wt% U235 discharged at EOC12.

The fresh fuel contained 592 gadolinia-bearing fuel rods in concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 16 operated to approximately 15,182 MWd/mtU.

Plant C Cycle 17

This cycle contained:

- 68 fresh zone-loaded fuel assemblies at 4.30/3.74 wt% U235.

The burned fuel assemblies included:

- 68 once-burnt zone-loaded assemblies at 4.40/3.83 wt% U235
- 80 twice-burnt zone-loaded assemblies at 4.43/3.85 wt% U235

The re-insert fuel assembly was:

- 1 twice-burnt zone-loaded assembly at 4.12/3.59 wt% U235 discharged at EOC12.

The fresh fuel contained 640 gadolinia-bearing fuel rods in concentrations of 2, 4, and 6 wt% Gd_2O_3. Cycle 17 operated to approximately 15,383 MWd/mtU.

Plant C Cycle 18

This cycle contained:

- 68 fresh zone-loaded fuel assemblies at 4.50/3.91 wt% U235.

The burned fuel assemblies included:

- 68 once-burnt zone-loaded assemblies at 4.30/3.74 wt% U235
- 68 twice-burnt zone-loaded assemblies at 4.40/3.83 wt% U235
- 12 thrice-burnt zone-loaded assemblies at 4.43/3.85 wt% U235

The re-insert fuel assembly was:

- 1 twice-burnt zone-loaded assembly at 4.30/3.74 wt% U235 discharged at EOC15.

The fresh fuel contained 656 gadolinia-bearing fuel rods in concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. Cycle 18 operated to approximately 15,647 MWd/mtU.

Plant G1 Cycles 26-30

Plant Type: Siemens reactor containing 177 assemblies

Fuel Type: 15x15 array with the guide tube configuration shown in Appendix G1 Figure G1 10.2.1-4.

Only limited startup physics data is available for this plant.

Plant G1 Cycle 26

This cycle contained 44 fresh fuel assemblies:

- 20 at 3.50 wt% U235,
- 8 at 3.75 wt% U235 and
- 16 at 4 wt% U235.

The burnt fuel assemblies included

- 32 once-burnt assemblies at 3.75 wt% U235,

- 8 twice-burnt assemblies at 3.50 wt% U235,
- 16 twice-burnt assemblies at 3.75 wt% U235,
- 33 thrice-burnt assemblies at 3.50 wt% U235,
- 16 thrice-burnt assemblies at 3.75 wt% U235, and
- 28 fourth-burnt assemblies at 3.50 wt% U235.

The fresh fuel contained 128 gadolinia-bearing fuel rods in a concentration of 2 wt% Gd_2O_3. Gadolinia fuel was used for the first time in cycle 26. Cycle 26 operated to approximately 12.796 GWd/mtU.

Plant G1 Cycle 27

This cycle contained 48 fresh fuel assemblies:

- 28 at 4.00 wt% U235 and
- 20 at 3.50 wt% U235.

The burnt fuel assemblies included

- 20 once-burnt assemblies at 3.50 wt% U235,
- 8 once-burnt assemblies at 3.75 wt% U235,
- 16 once-burnt assemblies at 4.00 wt% U235,
- 1 twice-burnt assembly at 3.50 wt% U235,
- 32 twice-burnt assemblies at 3.75 wt% U235,
- 8 thrice-burnt assemblies at 3.50 wt% U235,
- 16 thrice-burnt assemblies at 3.75 wt% U235,
- 8 fourth-burnt assemblies at 3.50 wt% U235, and
- 20 fifth-burnt assemblies at 3.50 wt% U235.

The fresh fuel did not contain any burnable absorbers. Cycle 27 operated to approximately 13.014 GWd/mtU.

Plant G1 Cycle 28

This cycle contained:

- 48 fresh fuel assemblies at 4.00 wt% U235.

The burnt fuel assemblies included

- 20 once-burnt assemblies at 3.50 wt% U235,
- 24 once-burnt assemblies at 4.00 wt% U235,
- 20 twice-burnt assemblies at 3.50 wt% U235,
- 8 twice-burnt assemblies at 3.75 wt% U235,
- 16 twice-burnt assemblies at 4.00 wt% U235,
- 4 thrice-burnt assemblies at 3.50 wt% U235,
- 29 thrice-burnt assemblies at 3.75 wt% U235, and
- 8 fourth-burnt assemblies at 3.75 wt% U235.

The fresh fuel contained 128 gadolinia-bearing fuel rods in a concentration of 5 wt% Gd_2O_3. Cycle 28 operated to approximately 13.053 GWd/mtU.

Plant G1 Cycle 29

This cycle contained 48 fresh fuel assemblies:

- 40 at 4.00 wt% U235,
- 4 at 3.75 wt% U235, and
- 4 at 3.50 wt% U235.

The burnt fuel assemblies included

- 52 once-burnt assemblies at 4.00 wt% U235,
- 20 twice-burnt assemblies at 3.50 wt% U235,
- 24 twice-burnt assemblies at 4.00 wt% U235,
- 16 thrice-burnt assemblies at 3.50 wt% U235,
- 5 thrice-burnt assemblies at 3.75 wt% U235,

- 4 thrice-burnt assemblies at 4.00 wt% U235, and
- 8 fifth-burnt assemblies at 3.50 wt% U235.

The fresh fuel contained 192 gadolinia-bearing fuel rods in a concentration of 5 wt% Gd_2O_3. Cycle 29 operated to approximately 13.057 GWd/mtU.

Plant G1 Cycle 30

This cycle contained 44 fresh fuel assemblies:

- 40 at 4.40 wt% U235, and
- 4 at 4.00 wt% U235.

The burnt fuel assemblies included

- 4 once-burnt assemblies at 3.50 wt% U235,
- 4 once-burnt assemblies at 3.75 wt% U235,
- 40 once-burnt assemblies at 4.00 wt% U235,
- 52 twice-burnt assemblies at 4.00 wt% U235,
- 4 thrice-burnt assemblies at 3.50 wt% U235,
- 1 thrice-burnt assemblies at 3.75 wt% U235,
- 20 thrice-burnt assemblies at 4.00 wt% U235, and
- 8 fourth-burnt assemblies at 3.50 wt% U235.

The fresh fuel contained 192 gadolinia-bearing fuel rods in a concentration of 5 wt% Gd_2O_3. Cycle 30 operated to approximately 12.922 GWd/mtU.

Plant G2 Cycles 1-5

Plant Type: Siemens - KONVOI reactor containing 193 assemblies

Fuel Type: 18x18 array with the guide tube configuration shown in Appendix G2 Figure G2 10.2.1-5.

Only limited startup physics data is available for this plant.

Plant G2 Cycle 1

This cycle was loaded with 193 fresh fuel assemblies:

- 69 at 1.9 wt% U235,
- 68 at 2.5 wt% U235, and
- 56 at 3.2 wt% U235.

The fresh fuel contained 1152 gadolinia-bearing fuel rods with concentrations of 3, 5, and 7 wt% Gd_2O_3. Cycle 1 reached an approximate burnup of 16.695 GWd/mtU.

Plant G2 Cycle 2

This cycle design loaded 72 fresh fuel assemblies:

- 4 at 3.2 wt% U235,
- 52 at 3.45 wt% U235, and
- 16 at 3.5 wt% U235.

The burnt fuel assemblies included

- 45 once-burnt assemblies at 1.9 wt% U235,
- 24 once-burnt assemblies at 2.5 wt% U235,
- and 52 once-burnt assemblies at 3.2 wt% U235.

The fresh fuel contained 624 gadolinia-bearing fuel rods in concentrations of 5 and 7 wt% Gd_2O_3. Cycle 2 reached an approximate burnup of 13.207 GWd/mtU.

Plant G2 Cycle 3

This cycle design loaded 64 fresh fuel assemblies:

- 48 at 3.45 wt% U235 and
- 16 at 3.5 wt% U235.

The burnt fuel assemblies included

- 4 once-burnt assemblies at 3.2 wt% U235,

- 52 once-burnt assemblies at 3.45 wt% U235,
- 12 once-burnt assemblies at 3.5 wt% U235,
- 28 once-burnt assemblies at 2.5 wt% U235 previously discharged at cycle 1,
- 4 once-burnt assemblies at 3.2 wt% U235 previously discharged at cycle 1,
- 28 twice-burnt assemblies at 1.9 wt% U235, and
- 1 twice-burnt assembly at 3.2 wt% U235.

The fresh fuel contained 576 gadolinia-bearing fuel rods in a concentration of 7 wt% Gd_2O_3. Cycle 3 reached an approximate burnup of 13.108 GWd/mtU.

Plant G2 Cycle 4

This cycle design loaded 64 fresh fuel assemblies:

- 44 at 3.45 wt% U235 and
- 20 at 3.5 wt% U235.

The burnt fuel assemblies included

- 48 once-burnt assemblies at 3.45 wt% U235,
- 8 once-burnt assemblies at 3.5 wt%, U235
- 16 once-burnt assemblies at 2.5 wt% U235 previously discharged at cycle 1,
- 8 once-burnt assemblies at 1.9 wt% U235 previously discharged at cycle 1,
- 8 twice-burnt assemblies at 3.5 wt% U235,
- 8 twice-burnt assemblies at 3.45 wt% U235,
- 8 twice-burnt assemblies at 3.2 wt% U235,
- 5 twice-burnt assemblies at 3.2 wt% U235 previously discharged at cycle 2,
- 8 twice-burnt assemblies at 2.5 wt% U235, and
- 12 thrice-burnt assemblies at 1.9 wt% U235.

The fresh fuel contained 528 gadolinia-bearing fuel rods in a concentration of 7 wt% Gd_2O_3. Cycle 4 reached an approximate burnup of 11.560 GWd/mtU.

Plant G2 Cycle 5

This cycle design loaded 44 fresh fuel assemblies:

- 32 at 3.8 wt% U235,
- 4 at 3.5 wt% U235, and
- 8 at 3.45 wt% U235.

The burnt fuel assemblies included

- 20 once-burnt assemblies at 3.5 wt% U235,
- 44 once-burnt assemblies at 3.45 wt%, U235,
- 8 once-burnt assemblies at 3.5 wt% U235 previously discharged at cycle 3,
- 8 twice-burnt assemblies at 3.5 wt% U235,
- 36 twice-burnt assemblies at 3.45 wt% U235,
- 21 twice-burnt assemblies at 3.2 wt% U235 previously discharged in cycle 2,
- 4 twice-burnt assemblies at 3.5 wt% U235 previously discharged at cycle 3, and
- 8 twice-burnt assemblies at 3.45 wt% U235 previously discharged at cycle 3.

The fresh fuel contained 336 gadolinia-bearing fuel rods in a concentration of 7 wt% Gd_2O_3. Cycle 5 reached an approximate burnup of 11.608 GWd/mtU.

Plant S1 Cycles 12-14

Plant Type: Westinghouse reactor containing 193 assemblies

Fuel type: 17x17 array with Westinghouse guide tube (configuration is similar to that presented in Figure A 10.2.1-1 in Appendix A) configuration.

Plant S1 Cycle 12

This cycle was loaded with 76 fresh fuel assemblies:

- 44 at 4.20 wt% U235 and
- 32 at 4.50 wt% U235.

The burned fuel assemblies included:

- 85 once-burnt assemblies at 4.79, 4.59, 4.34, and 4.00 wt% U235, and
- 32 twice-burnt assemblies at 4.60 and 4.20 wt% U235.

The fresh fuel contained 1360 gadolinia bearing rods with concentrations of 6 and 8 wt% Gd_2O_3. Cycle 12 reached an approximate burnup of 18.705 GWd/mtU.

Plant S1 Cycle 13

This cycle was loaded with 76 fresh fuel assemblies:

- 52 at 4.40 wt% U235 and
- 24 at 4.70 wt% U235.

The burned fuel assemblies included:

- 77 once-burnt assemblies at 4.50, 4.20, and 4.59 wt% U235, and
- 40 twice-burnt assemblies at 4.79, 4.59, and 4.00 wt% U235.

The fresh fuel contained 32 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 1440 gadolinia bearing rods with concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 13 reached an approximate burnup of 19.024 GWd/mtU.

Plant S1 Cycle 14

This cycle was loaded with 76 fresh fuel assemblies:

- 56 at 4.40 wt% U235 and
- 20 at 4.70 wt% U235.

The burned fuel assemblies included:

- 77 once-burnt assemblies at 4.70, 4.40, and 4.34 wt% U235, and
- 40 twice-burnt assemblies at 4.5 and 4.2 wt% U235.

The fresh fuel contained 32 discrete burnable absorber rods utilizing B_4C pellets, which were loaded in guide tube locations, and 1472 gadolinia bearing rods with concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. Cycle 14 reached an approximate burnup of 19.572 GWd/mtU.

Plant S2 Cycles 12-14

Plant Type: Westinghouse reactor containing 193 assemblies

Fuel type: 17x17 array with Westinghouse guide tube (configuration is similar to that presented in Figure A 10.2.1-1 in Appendix A) configuration.

Plant S2 Cycle 12

This cycle was loaded with 80 fresh fuel assemblies:

- 48 at 4.50 wt% U235 and
- 32 at 4.80 wt% U235.

The burned fuel assemblies included:

- 81 once-burnt assemblies at 4.80, 4.50, and 4.59 wt% U235, and
- 32 twice-burnt assemblies at 4.60 and 4.30 wt% U235.

The fresh fuel contained 32 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 1696 gadolinia bearing rods with concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 12 reached an approximate burnup of 19.779 GWd/mtU.

Plant S2 Cycle 13

This cycle was loaded with 77 fresh fuel assemblies:

- 49 at 4.50 wt% U235 and
- 28 at 4.80 wt% U235.

The burned fuel assemblies included:

- 76 once-burnt assemblies at 4.80 and 4.50 wt% U235, and
- 40 twice-burnt assemblies at 4.80 and 4.50 wt% U235.

The fresh fuel contained 48 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 1544 gadolinia bearing rods with concentrations of 2, 4, 6, and 8 wt% Gd_2O_3. Cycle 13 reached an approximate burnup of 18.566 GWd/mtU.

Plant S2 Cycle 14

This cycle was loaded with 80 fresh fuel assemblies:

- 40 at 4.30 wt% U235 and
- 40 at 4.60 wt% U235.

The burned fuel assemblies included:

- 77 once-burnt assemblies at 4.80 and 4.50 wt% U235, and
- 36 twice-burnt assemblies at 4.80 and 4.50 wt% U235.

The fresh fuel contained 1696 gadolinia bearing rods with concentrations of 4, 6, and 8 wt% Gd_2O_3. Cycle 14 reached an approximate burnup of 21173 GWd/mtU.

Plant T1 Cycles 9-15

Plant Type: Babcock & Wilcox reactor containing 177 assemblies

Fuel type: 15x15 array with the guide tube configuration as shown in Appendix T1 Figure T1 10.2.1-6.

Plant T1 Cycle 9

This cycle was loaded with 80 fresh fuel assemblies:

- 20 at 3.63 wt% U235,
- 4 at 3.90 wt% U235 and
- 56 at 4.0 wt% U235.

The burned fuel assemblies included:

- 76 once-burnt assemblies at 2.85 and 3.63 wt% U235,
- 9 twice-burnt assemblies at 2.85 wt% U235 and
- 12 third-burnt assemblies at 2.85 wt% U235.

The fresh fuel contained 896 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations. Cycle 9 reached an approximate burnup of 20.012 GWd/mtU.

Plant T1 Cycle 10

This cycle was loaded with 80 fresh fuel assemblies:

- 8 at 4.00 wt% U235,
- 48 at 4.65 wt% U235 and
- 24 at 4.75 wt% U235.

The burned fuel assemblies included:

- 76 once-burnt assemblies at 3.63 and 4.00 wt% U235 and
- 21 twice-burnt assemblies at 3.63 wt% U235.

The fresh fuel contained 896 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 112 gadolinia bearing rods with a concentration of 2.00 wt% Gd_2O_3. Cycle 10 reached an approximate burnup of 20.658 GWd/mtU.

Plant T1 Cycle 11

This cycle was loaded with 80 fresh fuel assemblies:

- 20 at 4.00 wt% U235,
- 32 at 4.23 wt% U235,
- 4 at 4.25 wt% U235 and
- 24 at 4.55 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt assemblies at 4.65 and 4.75 wt% U235 and
- 25 twice-burnt assemblies at 3.63 and 4.00 wt% U235.

The fresh fuel contained 768 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 192 gadolinia bearing rods with a concentration of 2.00 wt% Gd_2O_3. Cycle 11 reached an approximate burnup of 21.432 GWd/mtU.

Plant T1 Cycle 12

This cycle was loaded with 72 fresh fuel assemblies:

- 8 at 4.25 wt% U235,
- 4 at 4.55 wt% and
- 60 at 4.75 wt% U235.

The burned fuel assemblies included:

- 80 once-burnt assemblies at 4.00, 4.23, 4.25 and 4.55 wt% U235 and
- 25 twice-burnt assemblies at 3.63, 4.65 and 4.75 wt% U235.

The fresh fuel contained 768 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 368 gadolinia bearing rods with a concentration of 2.00 wt% Gd_2O_3. Cycle 12 reached an approximate burnup of 21.327 GWd/mtU.

Plant T1 Cycle 13

This cycle was loaded with 72 fresh fuel assemblies:

- 40 at 4.65 wt% U235 and
- 32 at 4.70 wt% U235.

The burned fuel assemblies included:

- 76 once-burnt assemblies at 4.00, 4.23, 4.25, 4.55 and 4.75 wt% U235 and

- 29 twice-burnt assemblies at 3.63, 4.00, 4.23 and 4.55 wt% U235.

The fresh fuel contained 768 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 560 gadolinia bearing rods with concentration of 2.00 wt% Gd_2O_3. Cycle 13 reached an approximate burnup of 21.669 GWd/mtU.

Plant T1 Cycle 14

This cycle was loaded with 72 fresh fuel assemblies:

- 20 at 4.45 wt% U235,
- 16 at 4.62 wt% U235 and
- 36 at 4.90 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt assemblies at 4.65, 4.70 and 4.75 wt% U235 and
- 33 twice-burnt assemblies at 4.00 and 4.75 wt% U235.

The fresh fuel contained 768 discrete burnable absorber rods utilizing B_4C pellets, which were loaded into guide tube locations, and 576 gadolinia bearing rods with a concentration of 2.00 wt% Gd_2O_3. Cycle 14 reached an approximate burnup of 20.702 GWd/mtU.

Plant T1 Cycle 15

This cycle was loaded with 68 fresh fuel assemblies:

- 28 at 4.45 wt% U235,
- 24 at 4.78 wt% U235 and
- 16 at 4.90 wt% U235.

The burned fuel assemblies included:

- 72 once-burnt assemblies at 4.45, 4.62, 4.65 and 4.90 wt% U235 and
- 37 twice-burnt assemblies at 4.00, 4.65 and 4.70 wt% U235.

The fresh fuel contained 896 gadolinia bearing rods with concentrations of 3.00 and 8.00 wt% Gd_2O_3. Cycle 15 reached an approximate burnup of 20.414 GWd/mtU.

Plant V1 Cycles 18-22

Plant Type: Westinghouse reactor containing 157 assemblies

Fuel Type: 15x15 array with the guide tube configuration shown in Appendix V1 Figure V1 10.2.1-7

Only limited startup physics data is available for this plant.

Plant V1 Cycle 18

This cycle was loaded with 56 fresh fuel assemblies:

- 28 at 3.90 wt% U235, and
- 28 at 4.10 wt% U235.

The burned fuel assemblies included:

- 56 once-burnt assemblies at 3.90 wt% U235 and
- 45 twice-burnt assemblies at 3.90 wt% U235.

The fresh fuel contained 608 gadolinia-bearing fuel rods with concentrations of 8 and 10 wt% Gd_2O_3. The cycle reached an approximate burnup of 15.158 GWd/mtU.

Plant V1 Cycle 19

This cycle was loaded with 64 fresh fuel assemblies:

- 32 at 4.00 wt% U235,
- 28 at 4.20 wt% U235 and
- 4 at 4.10 wt% U235.

The burned fuel assemblies included:

- 56 twice-burnt assemblies at 3.90 and 4.10 wt% U235 and
- 37 once-burnt assemblies at 3.90 wt% U235.

The fresh fuel contained 640 gadolinia-bearing fuel rods with a concentration of 10 wt% Gd_2O_3. The cycle reached an approximate burnup of 18.797 GWd/mtU.

Plant V1 Cycle 20

This cycle was loaded with 72 fresh fuel assemblies:

- 8 at 4.00 wt% U235, and
- 64 at 4.25 wt% U235.

The burned fuel assemblies included:

- 64 twice-burnt assemblies at 4.00, 4.10 and 4.20 wt% U235 and
- 21 once-burnt assemblies at 3.90 and 4.10 wt% U235.

The fresh fuel contained 832 gadolinia-bearing fuel rods with a concentration of 10 wt% Gd_2O_3. The cycle reached an approximate burnup of 19.945 GWd/mtU.

Plant V1 Cycle 21

This cycle was loaded with 68 fresh fuel assemblies:

- 4 at 4.25 wt% U235, and
- 64 at 4.30 wt% U235.

The burned fuel assemblies included:

- 68 twice-burnt assemblies at 4.00, 4.20 and 4.25 wt% U235 and
- 21 once-burnt assemblies at 4.10 and 4.20 wt% U235

The fresh fuel contained 800 gadolinia-bearing fuel rods with a concentration of 10 wt% Gd_2O_3. The cycle reached an approximate burnup of 20.230 GWd/mtU.

Plant V1 Cycle 22

This cycle was loaded with 68 fresh fuel assemblies at 4.30 wt% U235.

The burned fuel assemblies included:

- 68 twice-burnt assemblies at 4.25 and 4.30 wt% U235 and
- 21 once-burnt assemblies at 4.10, 4.20 and 4.25 wt% U235.

The fresh fuel contained 800 gadolinia-bearing fuel rods with a concentration of 10 wt% Gd_2O_3. The cycle reached an approximate burnup of 19.373 GWd/mtU.

10.3 *Startup Physics Test Measurements*

Startup physics test predictions are compared to the available measured data at beginning-of-cycle for each cycle of each plant/fuel type. The parameters and criteria compared are:

1) All rods out critical boron concentration
   Criterion: Calculated within ± 50 ppm of measured or ± 500 pcm equivalent

2) Individual control bank worths
   Criterion: Individual bank worths calculated within ± 15% or ±100 pcm of measured, whichever is larger

3) Total control bank worth
   Criterion: Total bank worth calculated within ± 10% of measured

4) All rods out isothermal temperature coefficient
   Criterion: Calculated within ± 2 pcm/ºF of measured

The above list of parameters is representative of the startup physics test data typically available from commercial U.S. reactors at zero power conditions; however, some of the cycles that were analyzed for European plants, which have different startup criteria and certain startup physics test data are not available. The criteria for the parameters are based on the recommended test criteria provided in Reference 10.6-2.

Comparisons of ARCADIA® calculations with measured results for startup physics test measurements are summarized in Tables 10.5-1 and 10.5-2. Measured data has been adjusted to reflect the ARCADIA® delayed neutron parameters.

10.3.1 Startup Physics Summary for Plant A Cycles 1-14

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix A, Tables A 10.3.1-1 through A 10.3.1-17. Two cycles exceeded the ± 50 ppm criteria of the measured all rods out critical boron concentration; however, when the cycle-specific boron worth is applied to the ± 500 pcm equivalent criterion, both cycles are within the allowable acceptance criteria. The calculated value for Cycle 7 is 72 ppm less than measured, but is within the 500 pcm equivalent criterion of ± 78 ppm. The Cycle 8 calculated value is 61 ppm less than measured, but is also within the 500 pcm equivalent criterion of ± 80 ppm.

The deviation of 15.1% between measured and calculated BOC HZP worth of Control Bank D for Cycle 11 is considered anomalous and, therefore, is not considered when determining the applicability of the ARCADIA® control rod worth calculations. This conclusion is based on the fact that Control Bank D met the criterion in preceding as well as subsequent cycles. Also, all other control rod banks met the acceptance criteria in Cycle 11, including the total rod worth. These facts support the conclusion that the control rod worths calculated by ARCADIA® are acceptable.

10.3.2 Startup Physics Summary for Plant B Cycle 1

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix B Table B 10.3.2-1 through Table B 10.3.2-4. All data are within the acceptance criteria.

10.3.3 Startup Physics Summary for Plant C Cycles 10-18

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix C Table C 10.3.3-1 through Table C 10.3.3-11. All data are within the

acceptance criteria. Measured values for individual rod bank worths and total bank worth were not available for Cycle 18.

10.3.4 Startup Physics Summary for Plant G1 Cycles 26-30

Critical boron concentrations at HZP, ARO conditions, for all five cycles can be found in Appendix G1 Table G1 10.3.4-1. Three cycles exceeded the ± 50 ppm criterion for critical boron concentration at HZP, ARO, conditions; however, when the cycle-specific boron worths are applied to the ± 500 pcm equivalent criterion, all cycles are within the allowable acceptance criterion. For Cycle 28, the calculated value is 58 ppm less than measured, but is within the 500 pcm equivalent criterion of ± 60 ppm. Likewise, the Cycle 29 calculated value is 55 ppm less than measured, but is within the 500 pcm equivalent criterion of ± 61 ppm. In addition, the Cycle 30 calculated value is 58 ppm less than measured, but is also within the 500 pcm equivalent criterion of ± 63 ppm. Finally, the measured value for Cycle 26 may be suspect because the B10 isotopic abundance was not measured. Since 19.2 atom-% was measured for both Cycles 27 and 28, the same abundance was also assumed for Cycle 26. For Plant G1, control rod bank worth measurements at HZP and isothermal temperature coefficients at HZP are not available.

10.3.5 Startup Physics Summary for Plant G2 Cycles 1-5

Critical boron concentrations at HZP, ARO conditions, for all five cycles can be found in Appendix G2 Table G2 10.3.5-1. All five cycles are within the ± 50 ppm acceptance criterion. Control rod bank worth measurements at HZP and isothermal temperature coefficients at HZP are not available.

10.3.6 Startup Physics Summary for Plant S1 Cycles 12-14

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix S1 Tables S1 10.3.6-1 through S1 10.3.6-6.

Results of all comparisons (HZP ARO critical boron concentration, HZP individual control rod worth, HZP total control rod worth, and HZP ARO isothermal temperature coefficient) meet the applicable acceptance criteria.

10.3.7 Startup Physics Summary for Plant S2 Cycles 12-14

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix S2 Tables S2 10.3.7-1 through S2 10.3.7-6.

The results of all comparisons (HZP ARO critical boron concentration, HZP individual control rod worth, HZP total control rod worth, and HZP ARO isothermal temperature coefficient) meet the acceptance criteria.

10.3.8 Startup Physics Summary for Plant T1 Cycles 9-15

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix T1 Tables T1 10.3.8-1 through T1 10.3.8-10.

Comparisons of ARO critical boron concentrations are generally good, except for Cycle 10 which exceeds the ± 50 ppm criterion. The Cycle 10 calculated value is 57 ppm less than measured, but it is within the 500 pcm equivalent criterion of ± 74 ppm. All bank rod worths and isothermal temperature coefficients meet the acceptance criteria.

10.3.9 Startup Physics Summary for Plant V1 Cycle 18-25

Comparisons of ARCADIA® calculations with measured results are summarized in Appendix V1 Table V1 10.3.9-1 through Table V1 10.3.9-8. All data is within the acceptance criteria.

10.4 *Core Follow Measurements*

Core follow comparisons include two different plant/fuel types with additional data, as available from Siemens type reactors. A total of 52 cycles have been considered, which exceeds the minimum criterion of 9 cycles set forth in Reference10.6-2. Core follow

predictions are compared to the available data measured at, or near, hot full power for each cycle of each plant/fuel type. The parameters compared are:

1) Critical boron concentrations

   Criterion: Calculated within ± 50 ppm measured or ± 500 pcm equivalent

   Comparisons are performed for a minimum of one measured data point per 30 effective full power days (EFPD) throughout the cycle. These comparisons may use a trend of the measured data in order to avoid a comparison with a measurement anomaly.

2) Assembly average power distributions

   Criterion: The root mean square (RMS) * 100 of the absolute differences between calculated and measured assembly powers is < 5.0 for each comparison map.

   At least three comparison maps are provided per cycle, corresponding to the beginning-, middle-, and end-of-cycle conditions. These comparisons may be in a full-core format or, if the core loading is quarter-core symmetric, the symmetrically located assembly powers may be averaged to allow comparisons in a quarter-core format.

3) Core average axial power distributions

   Criterion: The root mean square (RMS) *100 of the absolute differences between the calculated and measured core-average axial powers is < 5.0 for each map. At least three comparisons are provided per cycle, corresponding to the beginning-, middle-, and end-of-cycle conditions.

Measured boron concentration and power distribution data are typically available from commercial reactor measurements at full power conditions as a function of cycle burnup. The criteria for these parameters are based on the recommended test criteria provided in Reference 10.6-2.

Comparison of ARCADIA® calculations with measured results are summarized in Tables 10.5-1 and 10.5-3. All results are within the specified criteria except as discussed below for one axial power plot.

10.4.1 Plant A Cycles 1-14

Results for Plant A Cycles 1-14 show good agreement with the HFP measured boron concentrations, core-average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix A Figures A 10.4.1-1 to A 10.4.1-14. Assembly power distribution comparisons are presented in Appendix A Figures A 10.4.1-15 to A 10.4.1-56. Axial power distributions are shown in Appendix A Figures A 10.4.1-57 to A 10.4.1-98.

10.4.2 Plant B Cycle 1

Measured HFP critical boron concentrations are available only at seven points throughout Cycle 1 for Plant B. All available HFP CBC data was used in the comparisons. Results for Plant B Cycle 1 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix B Figure B 10.4.2-1. Assembly power distribution comparisons are presented in Appendix B Figures B 10.4.2-2 through B 10.4.2-4. Axial power distributions are shown in Appendix B Figures B 10.4.2-5 through B 10.4.2-7.

10.4.3 Plant C Cycles 10-18

Results for Plant C Cycles 10-18 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions through all cycles. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix C Figures C 10.4.3-1 through C 10.4.3-9. Assembly power distributions are presented in Appendix C Figures C 10.4.3-10 through C 10.4.3-36. Axial power distributions are shown in Appendix C Figures C 10.4.3-37 through C 10.4.3-63.

10.4.4 Plant G1 Cycles 26-30

Boron letdown curves for Plant G1 Cycles 26 to 30 can be found in Appendix G1 Figures G1 10.4.4-1 to G1 10.4.4-5. For Cycle 26, the B10 abundance was not measured. For Cycles 27 and 28, the measured value was 19.2 atom percent; therefore, the same value was also assumed for Cycle 26. For Cycle 29 and 30, the B10 isotope has been enriched to about 30 atom percent; however, deviations for all cycles are shown plotted in ppm of natural boron.

Cycles 27 to 29 were operated at 88% load at BOC, up to 28.7 EFPD for Cycle 27, and up to 15.6 EFPD for Cycle 28, due to a generator only becoming available after start-up of the reactor. For the same reason, Cycle 29 operated at 90% load at BOC, up to 48.6 EFPD. In Cycle 28, power was reduced to 80% during coast-down, beginning at 318.1 EFPD, again due to a generator being unavailable. These reductions were taken into account in the calculations for all cycles. Full load was only reached after 4 EFPD in Cycle 30 because of a defect in the turbine, and a defect in a main cooling pump led to a load reduction to 62%, between 200 and 220 EFPD. These reductions were not modeled in the Cycle 30 calculation, since no measured data was available in the database for these periods of time.

The radial power distribution maps can be found in Appendix G1 Figures G1 10.4.4-6 through G1 10.4.4-20 and the core average axial power distributions in Appendix G1 Figures G1 10.4.4-21 through G1 10.4.4-35. All comparison points are within the applicable acceptance criteria.

10.4.5 Plant G2 Cycles 1-5

During the first half of Cycle 1, Plant G2 was operated in load-follow mode, averaging around 80% of full load. Therefore, measured HFP critical boron concentration is only available close to BOC and for the second half of Cycle 1. At 311 EFPD, near the end of Cycle 2, the core rated power was increased from 3765 MW to 3850 MW, and the plant was operated at this higher rated power level for all subsequent cycles. During Cycle 4, power was reduced to 93%, and the resulting rise in critical boron concentration was compensated by partial insertion of a control rod bank.

The results for the plant G2 cycles show good agreement with the HFP measured boron concentrations and core average radial power distributions. All comparison points are within the acceptance criteria. The agreement with the measured axial power distributions for Cycle 1 is 6.5% at BOC, exceeding the 5% criterion. This is related to the operation mode of plant G2 which, as mentioned above, was not stationary during the first half of this cycle. Therefore, it was not possible to exactly model the reactor state at BOC in the calculation. All other axial power distribution maps are within the acceptance criteria. The axial power distribution map for BOC 1 will thus be considered an anomaly which does not influence the applicability of the ARCADIA® power distribution calculations.

The boron letdown curves for Cycles 1 to 5 can be found in Appendix G2 Figures G2 10.4.5-1 to G2 10.4.5-5. The radial power distribution maps can be found in Appendix G2 Figures G2 10.4.5-6 through G2 10.4.5-20 and the core average axial power distributions in Appendix G2 Figures G2 10.4.5-21 through G2 10.4.5-35.

10.4.6 Plant S1 Cycles 12-14

Results for Cycles 12-14 of Plant S1 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix S1 Figures S1 10.4.6-1 to S1 10.4.6-3. Assembly power distributions are presented in Appendix S1 Figures S1 10.4.6-4 to S1 10.4.6-12. Axial power distributions are presented in Appendix S1 Figures S1 10.4.6-13 to S1 10.4.6-21.

10.4.7 Plant S2 Cycles 12-14

Results for Cycles 12-14 of Plant S2 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix S2 Figures S2 10.4.7-1 to S2 10.4.7-3. Assembly power distributions are presented in Appendix S2 Figures S2 10.4.7-4 to S2 10.4.7-12. Axial power distributions are presented in Appendix S2 Figures S2 10.4.7-13 to S2 10.4.7-21.

10.4.8 Plant T1 Cycles 9-15

Results for Cycles 9-15 of Plant T1 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The location of the instrument tube is shown in Appendix T1 Figure T1 10.2.1-6. The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix T1 Figures T1 10.4.8-1 to T1 10.4.8-7. Assembly power distribution comparisons are presented in Appendix T1 Figures T1 10.4.8-8 to T1 10.4.8-28. Axial power distributions are shown in Appendix T1 Figures T1 10.4.8-29 to T1 10.4.8-49.

10.4.9 Plant V1 Cycles 18-22

Results for Cycles 18-22 of Plant V1 show good agreement with the HFP measured boron concentrations, core average axial power distributions, and radial power distributions. All comparison points are within the applicable acceptance criteria.

The HFP ARO critical boron concentration as a function of fractional cycle length is shown in Appendix V1 Figures V1 10.4.9-1 to V1 10.4.9-5. Assembly power distribution comparisons are presented in Appendix V1 Figures V1 10.4.9-6 to V1 10.4.9-20. Axial power distributions are shown in Appendix V1 Figures V1 10.4.9-21 to V1 10.4.9-35.

10.5 *Conclusions*

Table 10.5-1: Summary of ARCADIA® Validation Criteria and Results

Parameter	**Criteria**	**ARCADIA® Result**
Startup Physics Test		
ARO HZP Critical Boron Concentration	Maximum absolute difference <50 ppm or <500 pcm equivalent	Maximum absolute difference 46 ppm or <500 pcm equivalent
Individual HZP Control Bank Worths	Maximum absolute difference 15% or 100 pcm, whichever is larger	Maximum absolute difference 14.5%[a]
Total HZP Control Bank Worths	Maximum absolute difference <10%	Maximum absolute difference 9.6%
ARO HZP Isothermal Temperature Coefficient	Maximum absolute difference of <2.0 pcm/ºF	Maximum absolute difference 1.43 pcm/ºF
Core Follow Measurements		
HFP Critical Boron Concentrations	Maximum absolute difference measured and calculated <50 ppm or <500 pcm equivalent	Maximum absolute difference measured and calculated <50 ppm
Assembly Average Power Distributions	Maximum RMS*100 difference <5.0	Maximum RMS*100 difference 2.9
Core Average Axial Power Differences	Maximum RMS*100 difference <5.0	Maximum RMS*100 difference 4.7[b]

[a] Excludes one anomalous data point, see sub-section 10.3.1.
[b] Excludes one G2 anomalous map, see sub-section 10.4.5.

Table 10.5-2: Results of ARCADIA® Calculations with Startup Physics Test Measurements

Description	Results	Criteria	Comments
Plant/fuel types	6	>3	Plants (A, B and V1), C, G1, G2, (S1 and S2), and T1
Number of Westinghouse plant types	2	>1	Plants (A, B and V1) and (S1 and S2)
Number of Combustion Engineering plant types	1	1	Plant C
Number of Siemens plant types	2	>1	Plants G1 and G2
Number of B&W plant types	1	1	Plant T1
Number of evaluated cycles per plant type	20 cycles for Westinghouse reactors with 157 assemblies, 6 cycles for Westinghouse with 193 assemblies 5 cycles for Siemens - KONVOI reactor with 193 assemblies, 5 cycles for Siemens reactor with 177 assemblies, 9 cycles for Combustion Engineering reactor with 217 assemblies, 7 cycles for B&W reactor with 177 assemblies	>3	14 Cycles for Plant A, 1 Cycle for Plant B, 9 Cycles for Plant C, 5 Cycles for Plant G1, 5 Cycles for Plant G2, 3 Cycles for Plant S1 3 Cycles for Plant S2 7 Cycles for Plant T1 5 Cycles for Plant V1
Total number of evaluated cycles	52	>9	
ARO HZP Critical Boron Concentrations	Maximum absolute difference of 46 ppm or <500 pcm equivalent	Maximum absolute difference 50 ppm or <500 pcm equivalent	See Table A 10.3.1-1 and equivalent tables in Appendices for other plants.
Individual HZP Control Bank Worths	Maximum absolute difference 14.5%[a]	Maximum absolute difference 15% or 100 pcm, whichever is larger	See Tables A 10.3.1-2 through A 10.3.1-15 and equivalent tables in Appendices for other plants. Data unavailable for Siemens reactors.
Total HZP Control Bank Worths	Maximum absolute difference 9.6%	Maximum absolute difference 10%	See Table A 10.3.1-16 and equivalent tables in appendices for other plants. Data unavailable for Siemens reactors.
ARO HZP Isothermal Temperature Coefficient	Maximum absolute difference 1.43 pcm/ºF	Maximum absolute difference 2.0 pcm/ºF	See Table A 10.3.1-17 and equivalent tables in appendices for other plants. Data unavailable for Siemens reactors.

[a] Excludes one anomalous data point, see sub-section 10.3.1.

Table 10.5-3: Results of ARCADIA® Calculations with Core Follow Measurements

Description	Results	Criteria	Comments
Plant/fuel types	6	>3	Plants (A, B and V1), C, G1, G2, (S1 and S2), and T1
Number of Westinghouse plant types	2	>1	Plants (A, B and V1) and (S1 and S2)
Number of Combustion Engineering plant types	1	1	Plant C
Number of Siemens plant types	2	>1	Plants G1 and G2
Number of B&W plant types	1	1	Plant T1
Number of evaluated cycles per plant type	20 cycles for Westinghouse reactors with 157 assemblies, 6 cycles for Westinghouse with 193 assemblies 5 cycles for Siemens - KONVOI reactor with 193 assemblies, 5 cycles for Siemens reactor with 177 assemblies, 9 cycles for Combustion Engineering reactor with 217 assemblies, 7 cycles for B&W reactor with 177 assemblies	>3	14 Cycles for Plant A, 1 Cycle for Plant B, 9 Cycles for Plant C, 5 Cycles for Plant G1, 5 Cycles for Plant G2, 3 Cycles for Plant S1 3 Cycles for Plant S2 7 Cycles for Plant T1 5 Cycles for Plant V1
Total number of evaluated cycles	52	>9	
HFP Critical Boron Concentrations	Minimum of one measured data point per 30 EFPD for US plants or as available for European plants	Minimum of one measured data point per 30 EFPD	Plots provided in Appendices by plant. Frequency of data available for European plants does not meet 30 EFPD criteria.
	Maximum absolute difference between trend of measured data and calculated data <50 ppm	Maximum absolute difference <50 ppm or <500 pcm equivalent	
Assembly Average Power Distributions	Maximum RMS*100 difference of 2.9	Maximum RMS*100 difference <5.0	Maps provided for BOC, MOC, and EOC conditions in Appendices by plant
Core Average Axial Power Distributions	Maximum RMS*100 difference of 4.7[a]	Maximum RMS*100 difference <5.0	Plots provided for BOC, MOC, and EOC conditions in Appendices by plant

[a] Excludes one G2 anomalous map, see sub-section 10.4.5.

10.6 *References*

10.6-1 "Reactor Analysis System for PWRs," EMF-96-029(P)(A), Volumes 1 and 2.

10.6-2 "Reload Startup Physics Tests for Pressurized Water Reactors," ANSI/ANS-19.6.1-1995, American Nuclear Society, 1985.

10.6-3 "NEMO – Nodal Expansion Method Optimized," BAW-10180-A, December, 1992.

11.0 VALIDATION FOR TRANSIENT MODEL

11.1 *Neutron Flux Benchmarks*

Comparisons of ARTEMIS are made against the established benchmark problems without thermal feedbacks. These benchmarks include the TWIGL-2D step transient and the TWIGL-2D ramp transient analytical solutions.

The TWIGL Seed-Blanket problem consists of a square array reactor, which contains three compositions. A single delayed group is used and the problem involves only a neutronics calculation (with no transient moderator or fuel temperature effects). The mesh in the reference solution is sufficiently fine to qualify as a reference solution. Two cases are provided for the TWIGL-2D benchmark, a step change in reactivity and a ramp change in reactivity.

11.1.1 TWIGL-2D Step Transient

The step transient involves an immediate reduction in the thermal absorption cross-section for one composition type at the beginning of the transient. This transient represents a control rod ejection.

11.1.2 TWIGL-2D Ramp Transient

The ramp transient involves the same cross-section change as in the step transient except the change occurs linearly from 0.0 to 0.2 seconds. This transient represents a control rod withdrawal.

11.1.3 TWIGL-2D Results

The core average power response versus time for the step transient is shown in Figure 11.1-1 and the ramp transient is shown in Figure 11.1-2. Both cases use a time step size of 0.01 sec. As shown in the figures, the comparison between ARTEMIS and the reference case for these two transients is excellent. This excellent agreement indicates that the formulation of the kinetics neutron equations in ARTEMIS is correct.

Figure 11.1-1: TWIGL-2D Step Transient

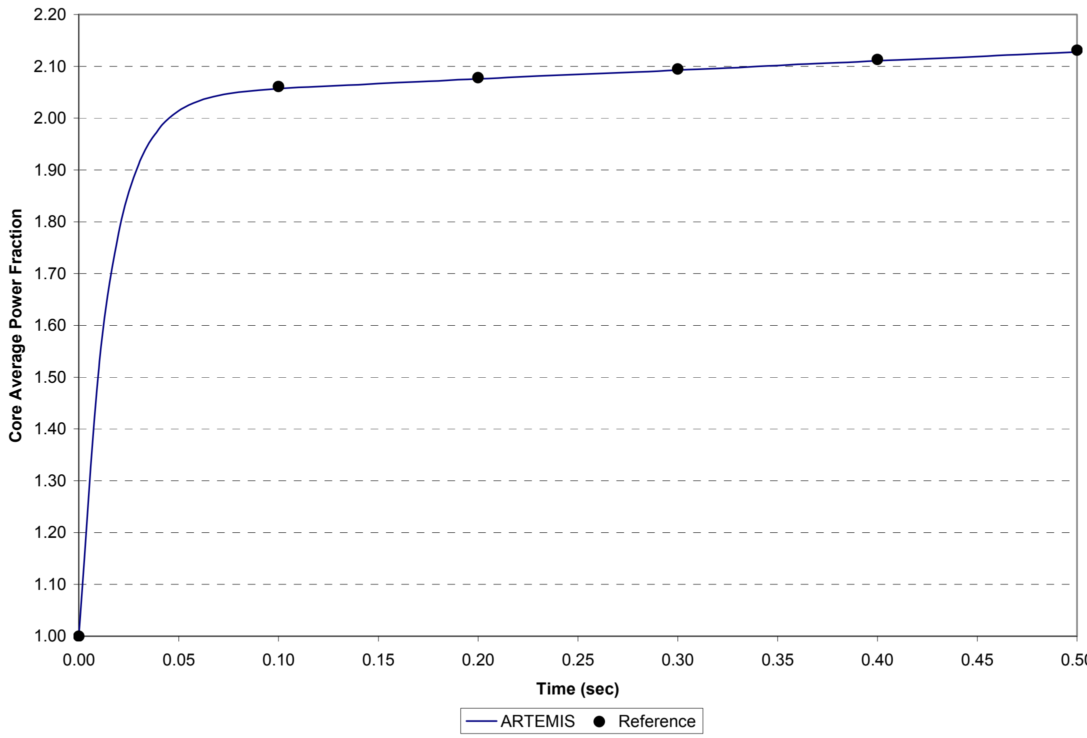
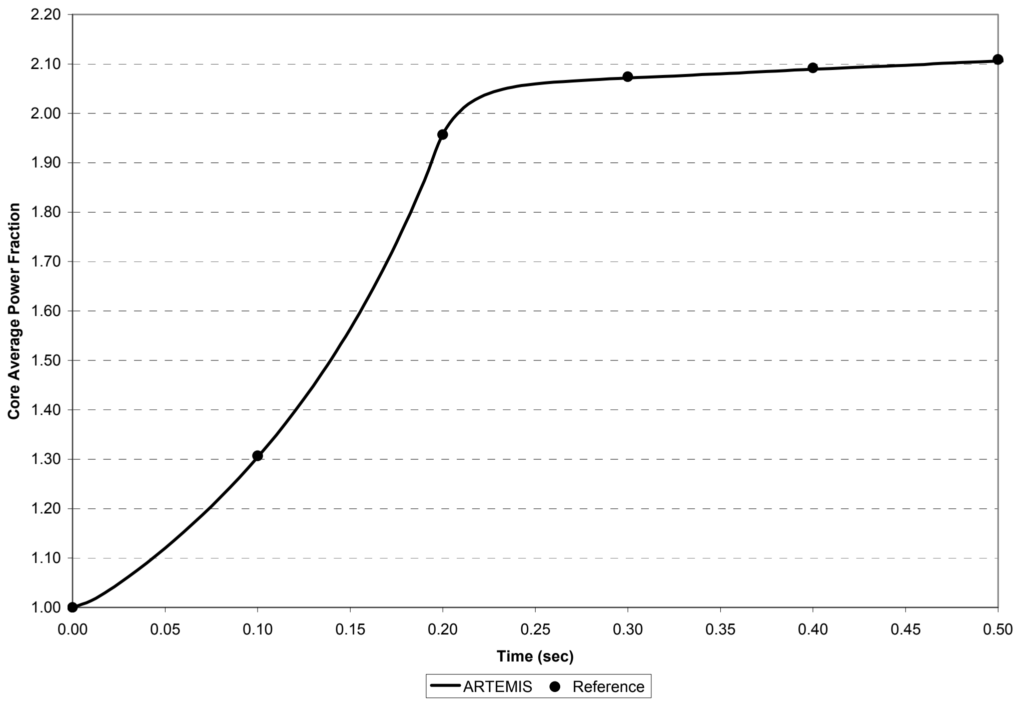


Figure 11.1-2: TWIGL-2D Ramp Transient



11.2 *NEACRP Reference Rod Ejection Benchmarks*

The NEACRP benchmarks are a set of analytical control rod ejection benchmarks. The specification document for these benchmarks is (Reference 11.4-1). This reference defines the core configurations, inputs, and conditions to be used for each transient modeled with ARTEMIS. The core modeled in the PWR transient is a 157 fuel assembly core. The nuclear data and its dependence on boron, moderator density, moderator temperature, fuel temperature, and control rods are defined in the reference. The reference also defines clad and fuel thermal properties.

11.2.1 NEACRP Case Description

There are six cases (A1, A2, B1, B2, C1, and C2) in the NEACRP benchmark problem. These cases represent control rod ejections from three different configurations (A, B, and C) and from both zero power (1) and full power (2) conditions. In the Case A transients, the center rod is ejected. In the Case B transients, a set of four periphery rods are ejected. Finally, the Case C transients eject a single periphery rod in the core. The zero power cases eject a fully inserted control rod and the full power cases eject a partially inserted control rod. The NEACRP cases provide a range of reactivity insertions and core conditions that provide an effective test of the coupled neutronics, fuel rod, and thermal-hydraulics transient responses.

A summary showing the results for several industry codes (Reference 11.4-2) used to model the NEACRP control rod ejections were compiled. The results from the PANTHER code (Reference 11.4-3) are typically used as the reference solution for the NEACRP control rod ejection benchmark cases. The reference results are included for comparison to ARTEMIS.

11.2.2 NEACRP Results

Comparisons of important steady-state parameters between ARTEMIS and the reference case are provided in Table 11.2.2-1. These conditions define the starting point prior to the transient. Agreement between the two codes is excellent. Boron

concentrations are within 9 ppm. Full power effective Doppler fuel temperatures are within 2.5 °C. The initial local peak is within 0.6%. The reactivity release for each case is within 4%. The reactivity release is the worth of the ejected rod with feedbacks on at the initial power level. The steady state comparisons verify that the input data is correct and that the static calculations using that data are very similar. Therefore, the initialization of the two codes is equivalent.

Table 11.2.2-2 provides a summary of kinetics results for ARTEMIS and the Reference cases. These comparisons include the power level at the time of peak power and at 5 seconds, and the core average Doppler fuel temperature at the point of maximum power and at 5 seconds. The Case A1 power distributions for axial plane 6 (0.34 fraction of core height) are presented in Figure 11.2.2-1, Figure 11.2.2-2, and Figure 11.2.2-3. These comparisons respectively represent the initial conditions, the point of peak power, and the conditions at 5 seconds. Note that the power distributions are normalized to 1.0 for the peak assembly. The time dependence of the core power, Doppler average fuel temperature, and core exit temperature for selected cases A1, B2, and C1 are provided in Figure 11.2.2-4 through Figure 11.2.2-12. The time dependent data for the reference case were extracted from the plots in Reference 11.4-2.

The agreement between ARTEMIS results and the reference values is very good. The ARTEMIS peak power for five of the six cases is higher than the reference case. The exception is Case B2 where the ARTEMIS peak power is the same as the peak power from the reference case. The time to peak power for the zero power cases are within 0.02 sec, and the time to peak power for the full power cases are within 0.06 sec. The average Doppler temperatures differences are within 2.5 °C at the time of peak power and within 3.0 °C throughout the transient. The core exit temperatures are within 1 °C throughout the transient. Comparison of the power distributions between ARTEMIS and the reference case show a maximum difference of 0.015 at the steady state condition and a maximum difference of 0.011 for the ejected rod condition. The comparisons from Figure 11.2.2-4 through Figure 11.2.2-12 show that ARTEMIS and the reference case comparisons are good and consistent throughout the transient.

These results show that the ARTEMIS code with the time dependent solutions neutronics coupled with the time dependent solutions for the fuel temperature and coolant properties, appropriately model the time dependent phenomena.

Table 11.2.2-1: Steady State Results for the NEACRP Benchmark

	ARTEMIS	Reference	Diff	%Diff
A1				
Steady State Boron (ppm)	560.1	567.7	-7.6	-1.3
Steady State Fuel Temperature (°C)	286	286	0.0	0.0
Steady State Nodal Peak	2.874	2.874	0.000	0.0
Reactivity Release (pcm)	821	822	-1	-0.1
A2				
Steady State Boron (ppm)	1152.4	1160.6	-8.2	-0.7
Steady State Fuel Temperature (°C)	548.2	546.1	2.1	0.4
Steady State Nodal Peak	2.228	2.221	0.007	0.3
Reactivity Release (pcm)	92	90	2	2.2
B1				
Steady State Boron (ppm)	1246.8	1254.6	-7.8	-0.6
Steady State Fuel Temperature (°C)	286	286	0.0	0.0
Steady State Nodal Peak	1.928	1.932	-0.004	-0.2
Reactivity Release (pcm)	824	831	-7	-0.8
B2				
Steady State Boron (ppm)	1180.9	1189.4	-8.5	-0.7
Steady State Fuel Temperature (°C)	545.8	543.7	2.1	0.4
Steady State Nodal Peak	2.122	2.109	0.013	0.6
Reactivity Release (pcm)	95	99	-4	-4.0
C1				
Steady State Boron (ppm)	1127.1	1135.3	-8.2	-0.7
Steady State Fuel Temperature (°C)	286	286	0.0	0.0
Steady State Nodal Peak	2.182	2.187	-0.005	-0.2
Reactivity Release (pcm)	945	958	-13	-1.4
C2				
Steady State Boron (ppm)	1152.4	1160.6	-8.2	-0.7
Steady State Fuel Temperature (°C)	548.2	546.1	2.1	0.4
Steady State Nodal Peak	2.228	2.221	0.007	0.3
Reactivity Release (pcm)	81	78	3	3.8

Table 11.2.2-2: Transient Results for the NEACRP Benchmark

	ARTEMIS	Reference	Diff	%Diff
A1				
Maximum Core Power Fraction	1.397	1.179	0.218	18.5
Core Power Fraction @ 5 sec	0.199	0.196	0.003	1.5
Time of Maximum Power (sec)	0.552	0.560	-0.008	-1.3
Fuel Temperature (°C) at Maximum Power	295.7	294.5	1.2	0.4
Fuel Temperature (°C) @ 5 sec	326.1	324.3	1.8	0.6
A2				
Maximum Core Power Fraction	1.088	1.080	0.008	0.7
Core Power Fraction @ 5 sec	1.036	1.035	0.001	0.1
Time of Maximum Power (sec)	0.150	0.100	0.050	50.0
Fuel Temperature (°C) at Maximum Power	548.9	546.5	2.4	0.4
Fuel Temperature (°C) @ 5 sec	557.6	554.6	3.0	0.5
B1				
Maximum Core Power Fraction	2.590	2.441	0.149	6.1
Core Power Fraction @ 5 sec	0.322	0.320	0.002	0.6
Time of Maximum Power (sec)	0.532	0.517	0.015	3.0
Fuel Temperature (°C) at Maximum Power	302.3	301.4	0.9	0.3
Fuel Temperature (°C) @ 5 sec	351.9	349.9	2.0	0.6
B2				
Maximum Core Power Fraction	1.063	1.063	0.000	0.0
Core Power Fraction @ 5 sec	1.038	1.038	0.000	0.0
Time of Maximum Power (sec)	0.175	0.120	0.055	45.8
Fuel Temperature (°C) at Maximum Power	546.4	544.1	2.3	0.4
Fuel Temperature (°C) @ 5 sec	554.3	552.0	2.3	0.4
C1				
Maximum Core Power Fraction	5.554	4.773	0.781	16.4
Core Power Fraction @ 5 sec	0.147	0.146	0.001	0.7
Time of Maximum Power (sec)	0.275	0.268	0.007	2.6
Fuel Temperature (°C) at Maximum Power	298.8	297.9	0.9	0.3
Fuel Temperature (°C) @ 5 sec	317.0	315.9	1.1	0.3
C2				
Maximum Core Power Fraction	1.080	1.071	0.009	0.8
Core Power Fraction @ 5 sec	1.032	1.030	0.002	0.2
Time of Maximum Power (sec)	0.125	0.100	0.025	25.0
Fuel Temperature (°C) at Maximum Power	548.6	546.4	2.2	0.4
Fuel Temperature (°C) @ 5 sec	556.3	553.5	2.8	0.5

Figure 11.2.2-1: Power Distribution at Initial Conditions (Plane 6) - Case A1

				0.293 0.282 -0.011	0.354 0.347 -0.007		
			0.752 0.750 -0.002	0.533 0.529 -0.004	0.497 0.492 -0.005	0.285 0.280 -0.005	Reference ARTEMIS (A-R)
		0.545 0.530 -0.015	0.757 0.757 0.000	0.393 0.381 -0.012	0.380 0.377 -0.003	0.206 0.199 -0.007	
	0.964 0.967 0.003	0.867 0.869 0.002	1.000 1.000 0.000	0.745 0.744 -0.001	0.301 0.291 -0.010	0.294 0.291 -0.003	0.226 0.222 -0.004
0.533 0.519 -0.014	0.793 0.796 0.003	0.575 0.560 -0.015	0.945 0.946 0.001	0.951 0.948 -0.003	0.527 0.525 -0.002	0.214 0.206 -0.008	0.285 0.281 -0.004

Peak Location

Rodded Location

Figure 11.2.2-2: Power Distribution at time of Maximum Power (Plane 6) - Case A1

				0.128 0.123 -0.005	0.150 0.147 -0.003		
			0.362 0.361 -0.001	0.242 0.240 -0.002	0.214 0.212 -0.002	0.120 0.117 -0.003	Reference ARTEMIS (A-R)
		0.316 0.307 -0.009	0.390 0.390 0.000	0.188 0.183 -0.005	0.169 0.168 -0.001	0.088 0.085 -0.003	
	0.790 0.791 0.001	0.562 0.563 0.001	0.540 0.540 0.000	0.371 0.370 -0.001	0.140 0.135 -0.005	0.126 0.125 -0.001	0.093 0.092 -0.001
1.000 1.000 0.000	0.778 0.780 0.002	0.390 0.379 -0.011	0.513 0.514 0.001	0.474 0.472 -0.002	0.248 0.247 -0.001	0.093 0.089 -0.004	0.117 0.115 -0.002

Peak Location

Rodded Location

Figure 11.2.2-3: Power Distribution at 5 sec (Plane 6) - Case A1

				0.143 0.138 -0.005	0.168 0.166 -0.002			
			0.392 0.393 0.001	0.266 0.266 0.000	0.239 0.238 -0.001	0.135 0.134 -0.001	Reference ARTEMIS (A-R)	
		0.333 0.324 -0.009	0.417 0.418 0.001	0.205 0.199 -0.006	0.188 0.187 -0.001	0.099 0.096 -0.003		
	0.802 0.804 0.002	0.581 0.583 0.002	0.569 0.571 0.002	0.397 0.398 0.001	0.153 0.149 -0.004	0.142 0.141 -0.001	0.106 0.105 -0.001	
1.000 1.000 0.000	0.785 0.788 0.003	0.403 0.393 -0.010	0.540 0.542 0.002	0.505 0.506 0.001	0.269 0.270 0.001	0.104 0.101 -0.003	0.134 0.132 -0.002	

Peak Location

Rodded Location

Figure 11.2.2-4: Core Power Fraction – Case A1

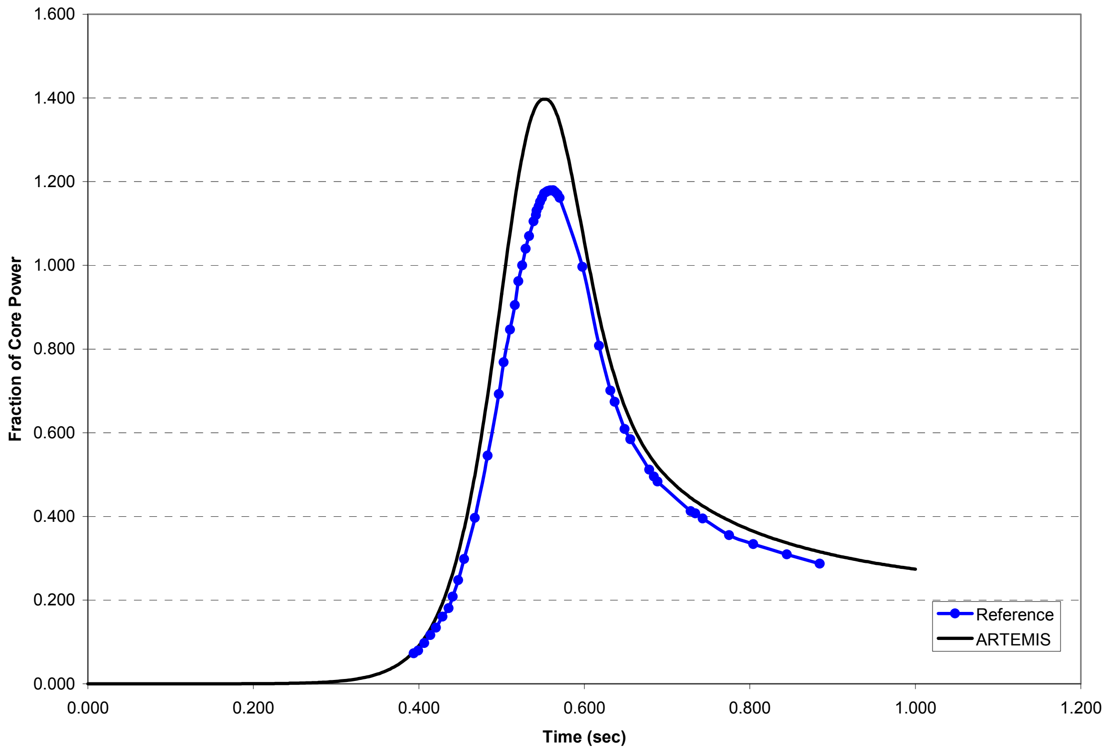


Figure 11.2.2-5: Core Average Fuel Temperature – Case A1

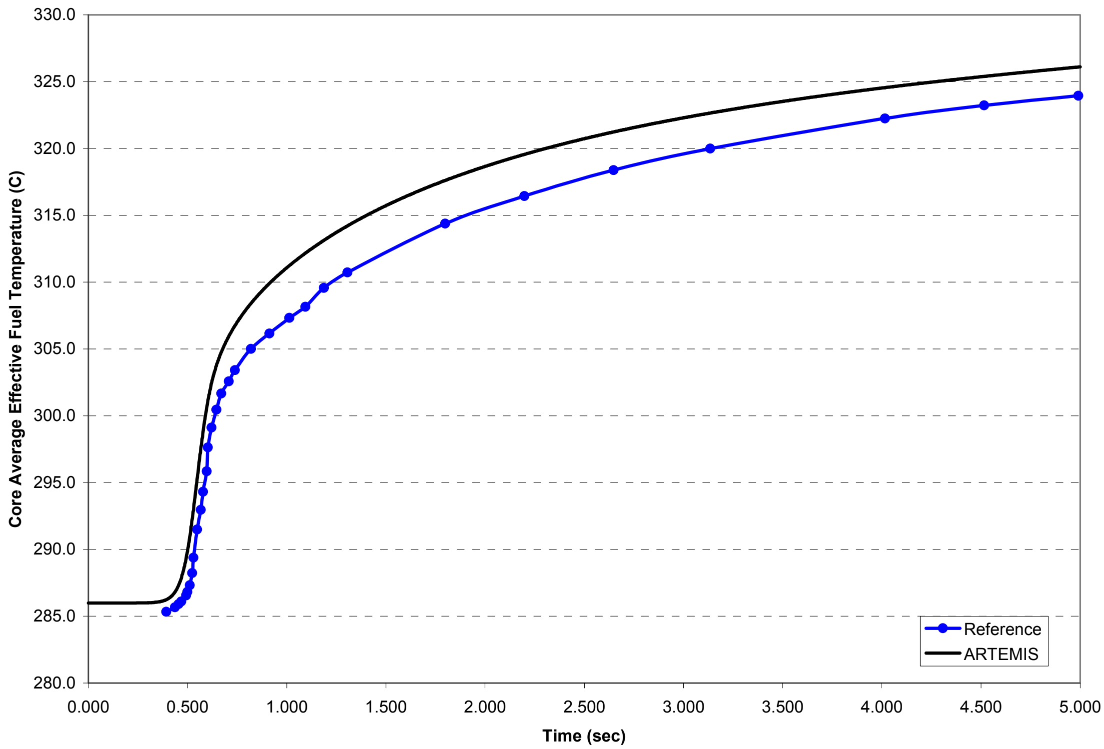


Figure 11.2.2-6: Core Exit Moderator Temperature – Case A1

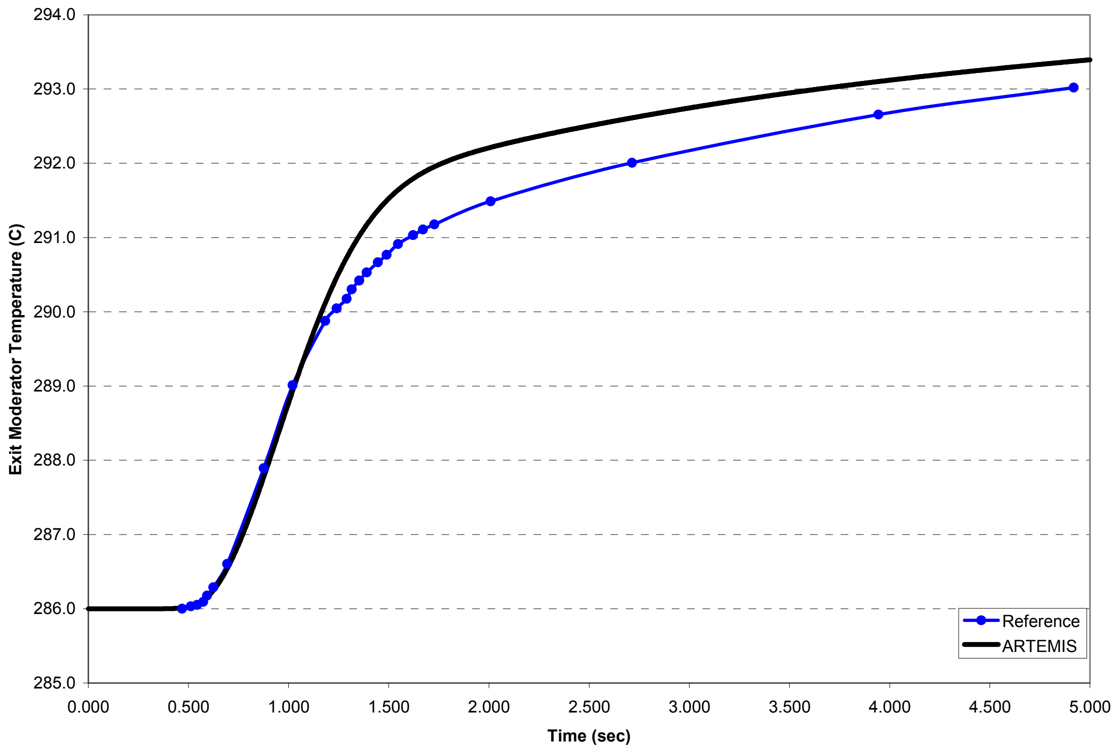


Figure 11.2.2-7: Core Power Fraction – Case B2

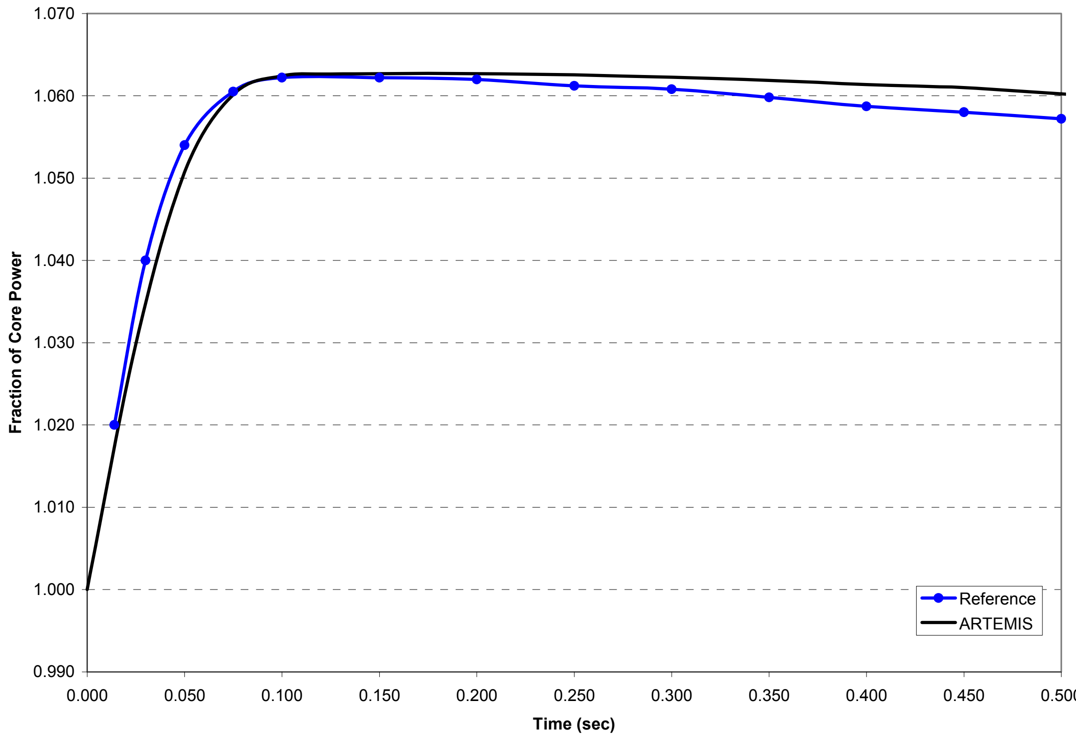


Figure 11.2.2-8: Core Average Fuel Temperature – Case B2

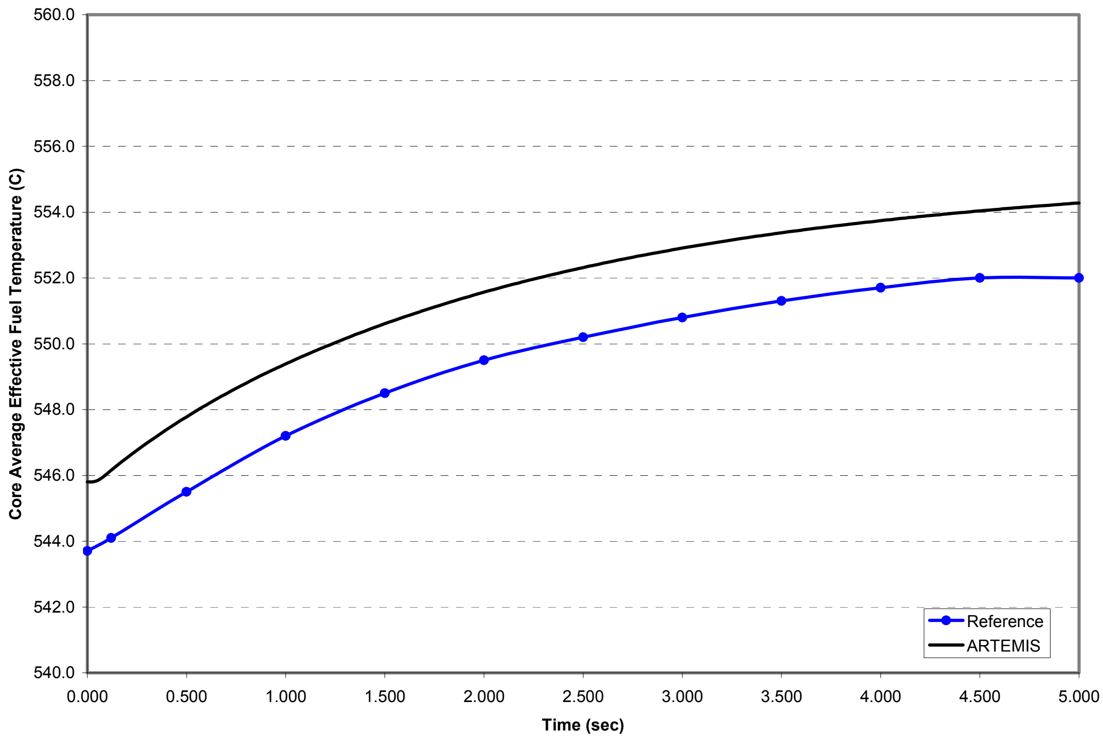


Figure 11.2.2-9: Core Exit Moderator Temperature – Case B2

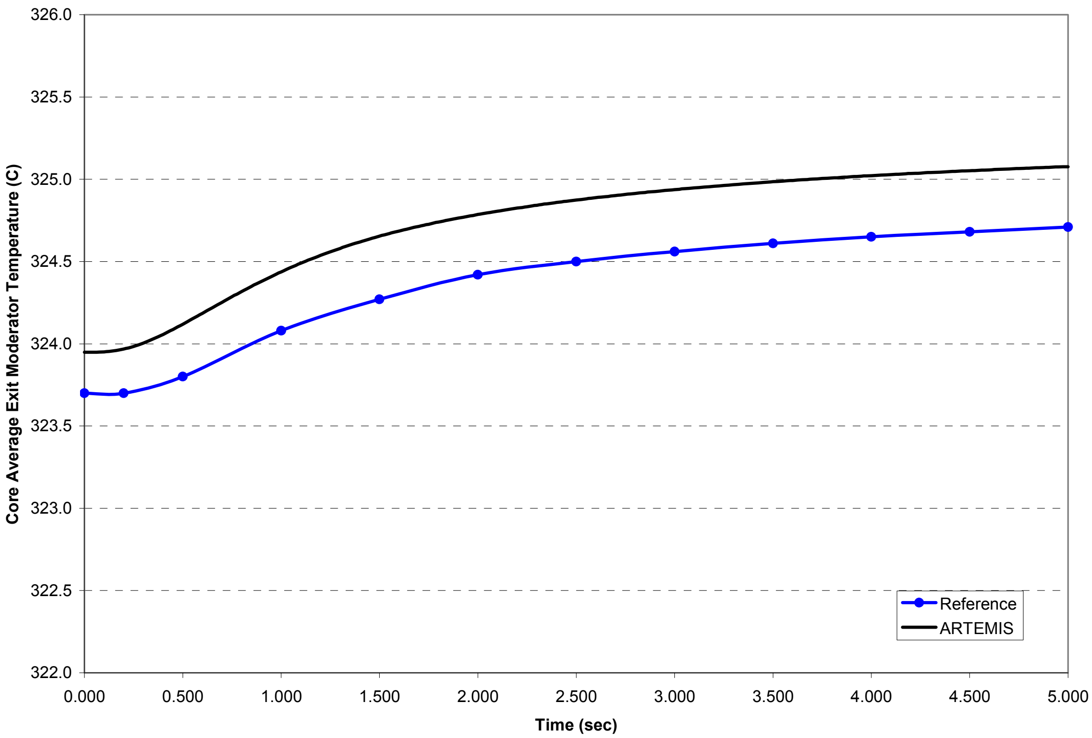


Figure 11.2.2-10: Core Power Fraction – Case C1

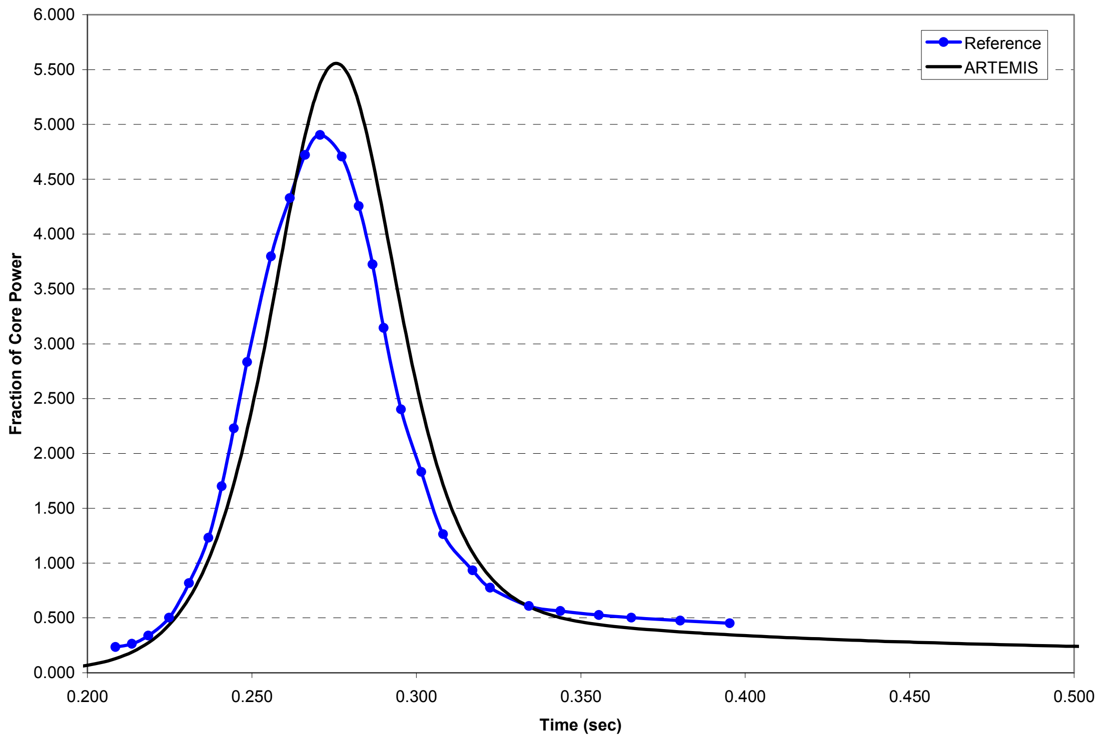


Figure 11.2.2-11: Core Average Fuel Temperature – Case C1

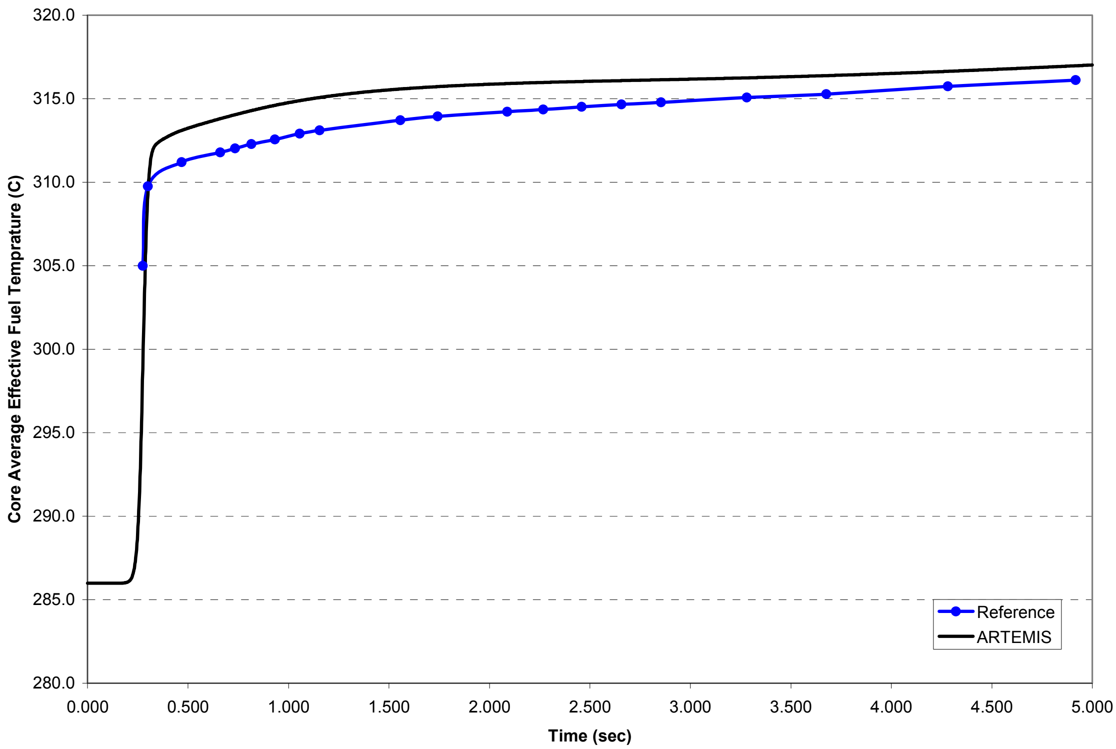
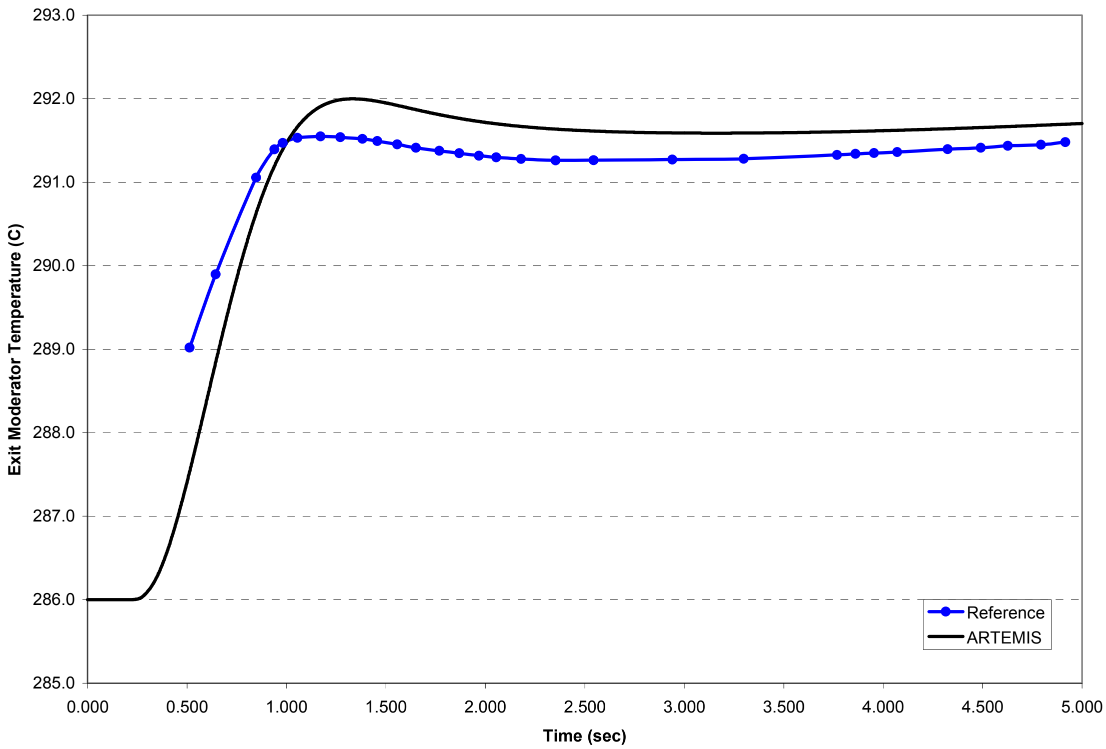


Figure 11.2.2-12: Core Exit Moderator Temperature – Case C1



11.3 ROD DROP TESTS

11.3.1 Rod Drop Test Description

Five rod drop tests were performed for three plants with193 fuel assemblies. Table 11.3-1 provides the operating conditions of the core prior to the rod drop tests.

In test 1, two interior, half core symmetric rods (F6 and K10) were dropped near Beginning of Cycle (0.7 GWd/mtU) with the reactor at 50% power. In this test, the rod velocities were provided separately for F06 and K10, but the signals are very similar and the results from the opposite sides of the core should remain the same. This was confirmed by the results of the calculation.

In tests 2 through 4, two interior, half core symmetric rods (K6 and F10 for test 2; K4 and F12 for test 3; E5 and L11 for test 4) were dropped near Middle of Cycle (4.34 GWd/MTU) with the reactor at 50.7% power.

In test 5, two interior, half core symmetric rods (F6 and K10) were dropped near End of Cycle (11.575 GWd/mtU) with the reactor at 50.1% power.

Since the core is half core symmetric during the tests, the excore response on the opposite sides of the core should be measuring the same signal.

The core layout with the positions of the control rods and excore detectors is shown in Figure 11.3-1.

11.3.2 Measured Data and Processing

During rod drop test, the control rod velocity and the four excore responses were obtained in electronic form. These electronic signals were processed to obtain the control rod position and the excore response versus time.

11.3.3 Calculation Model

The cross-sections were calculated with APOLLO2-A code. The core was depleted with the ARTEMIS code to the core condition presented in Table 11.3-1. The radial and axial reaction rate distributions of the core (measured channels) were then compared to the reaction rates obtained from the reprocessing of the flux maps.

The kinetic input data (precursor information and neutron velocity) were extracted from APOLLO2-A for the assembly types that make up the core in the three plants considered in the rod drop evaluation. These values were averaged based on the enrichment of different assembly types.

The excore responses were simulated in ARTEMIS using the peripheral assembly powers and the associated weighting factors are shown in Table 11.3-2.

11.3.4 Results

The ARTEMIS results are compared to the measured values in Figures 11.3-2 to 11.3-6 for each of the five rod drop tests. The first graphic of each figure shows the evolution of the nuclear flux (normalized to the core power) versus time. The second one of each figure shows the derivative of the nuclear flux dP/dt calculated with the Laplace transform function implemented in the measured system of the studied reactors. Comparisons between measured and calculation show excellent and consistent behavior prior to reaching the minimum nuclear flux and its derivative. In the last case (near End of Cycle), a deviation of about 1% was observed. In this test, an increased noise level was observed due to differences in the response between detector 1 and detector 2. The half core symmetric positions show a difference of 1%. During the second part of the rod drop test where there is an increase in the nuclear flux and its derivative, the predicted values are within 1% of the measured results in the cases near Beginning and Middle of Cycle and within 2% in the case near End of Cycle.

A synthesis over all rod drop tests is presented in Table 11.3-3 and in Figure 11.3-7. Two main parameters are analyzed:

- The time to reach the minimum dP/dt (maximum absolute value of dP/dt) – the maximum difference between predicted and measured values is -0.16 second. The average difference is -0.08 second with a standard deviation of 0.04 second.

The minimum dP/dt – the maximum difference between predicted and measured values is 0.81%NP/s. The average difference is 0.38%NP/s with a standard deviation of 0.34%NP/s. By considering a confidence of 95%, the maximum deviation on minimum dP/dt will be 1.04%NP/s, which is excellent.

Table 11.3-1: Core Conditions Prior to Rod Drop Tests

Case	Dropped rods	Bank R position (steps extracted)*	Cycle burnup (GWd/MTU)	Power fraction	Boron concentration (ppm)
1	F6K10 (SD)	217	0.7	0.5	802
2	K6F10 (SD)	185	4.34	0.507	666
3	K4F12 (SC)	187	4.34	0.507	666
4	E5L11 (R)	223	4.34	0.507	666
5	F6K10 (SD)	231	11.575	0.501	160

* 260 steps is fully extracted

Table 11.3-2: Weighting Factors Contribution to Excore Detector Response

		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
	Det3	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	**Det1**
1	?	?	?	?	?	**3.9**	**0.8**	**0**	**0**	**0**	**0.8**	**3.9**	?	?	?	?	?
2	?	?	?	**30.6**	**6.5**	**1.3**	**0**	**0**	**0**	**0**	**0**	**1.3**	**6.5**	**30.6**	?	?	?
3	?	?	**30.6**	**7.3**	**1.7**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.7**	**7.3**	**30.6**	?	?
4	?	?	**6.5**	**1.7**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.7**	**6.5**	?	?
5	?	**3.9**	**1.3**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.3**	**3.9**	?
6	?	**0.8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.8**	?
7	?	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	?
8	?	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	?
9	?	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	?
10	?	**0.8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.8**	?
11	?	**3.9**	**1.3**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.3**	**3.9**	?
12	?	?	**6.5**	**1.7**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.7**	**6.5**	?	?
13	?	?	**30.6**	**7.3**	**1.7**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0.4**	**1.7**	**7.3**	**30.6**	?	?
14	?	?	?	**30.6**	**6.5**	**1.3**	**0**	**0**	**0**	**0**	**0**	**1.3**	**6.5**	**30.6**	?	?	?
15	?	?	?	?	?	**3.9**	**0.8**	**0**	**0**	**0**	**0.8**	**3.9**	?	?	?	?	?
	Det2	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	**Det4**

x For excore detector 1

x For excore detector 2

x For excore detector 3

x For excore detector 4

Table 11.3-3: Results of Rod Drop - Synthesis

(a) Comparison (Prediction – Measurement) – Time of the minimal dP/dt

Time of minimal dP/dt (s)			
Average	1σ	Min	Max
-0.08	0.04	-0.16	-0.02

(b) Comparison (Prediction – Measurement) – Minimal dP/dt

Minimal dP/dt (%NP/s)				For 95% of confidence	
Average	1σ	Min	Max	Min	Max
0.38	0.34	-0.44	0.81	-0.28	1.04

Figure 11.3-1: Core Layout of 1300 MWe Reactor

		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A		
(3)					BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL					(1)
01			BAFL	BAFL	BAFL								BAFL	BAFL	BAFL			01
02		BAFL	BAFL		SA		SB		R		SB		SA		BAFL	BAFL		02
03		BAFL				G2		N2		N2		G2				BAFL		03
04	BAFL	BAFL	SA		N1		SC		G1		SC		N1		SA	BAFL	BAFL	04
05	BAFL			G2		R						R		G2			BAFL	05
06	BAFL		SB		SC		SD		N1		SD		SC		SB		BAFL	06
07	BAFL			N2										N2			BAFL	07
08	BAFL		R		G1		N1		R		N1		G1		R		BAFL	08
09	BAFL			N2										N2			BAFL	09
10	BAFL		SB		SC		SD		N1		SD		SC		SB		BAFL	10
11	BAFL			G2		R						R		G2			BAFL	11
12	BAFL	BAFL	SA		N1		SC		G1		SC		N1		SA	BAFL	BAFL	12
13		BAFL				G2		N2		N2		G2				BAFL		13
14		BAFL	BAFL		SA		SB		R		SB		SA		BAFL	BAFL		14
15			BAFL	BAFL	BAFL								BAFL	BAFL	BAFL			15
(2)					BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL	BAFL					(4)
		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A		

(N) **Excore Detector**

BAFL **Reflector**

Figure 11.3-2: Results of Rod Drop Test 1 — 0.7 GWd/mtU, F6K10 (SD bank)

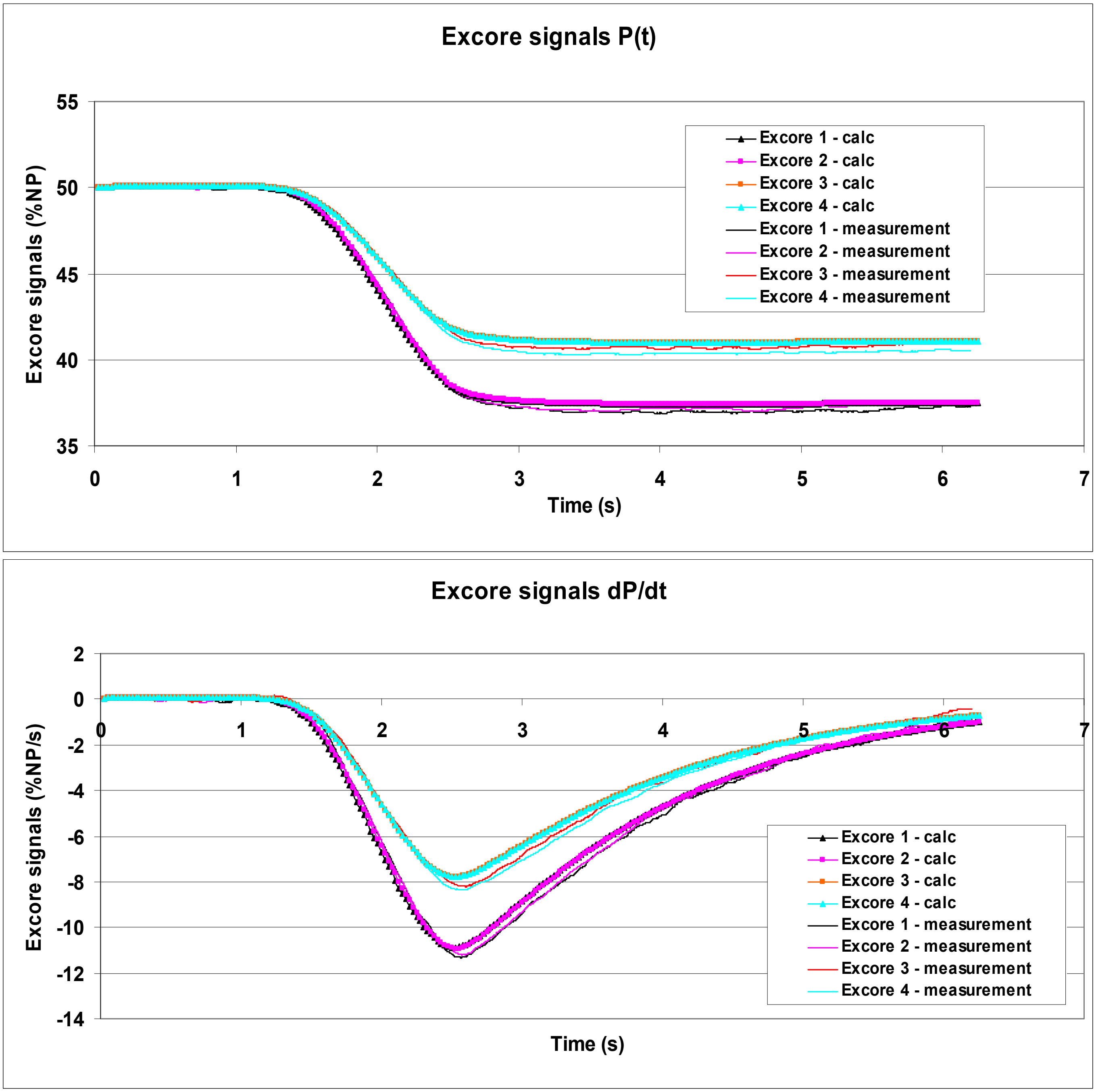
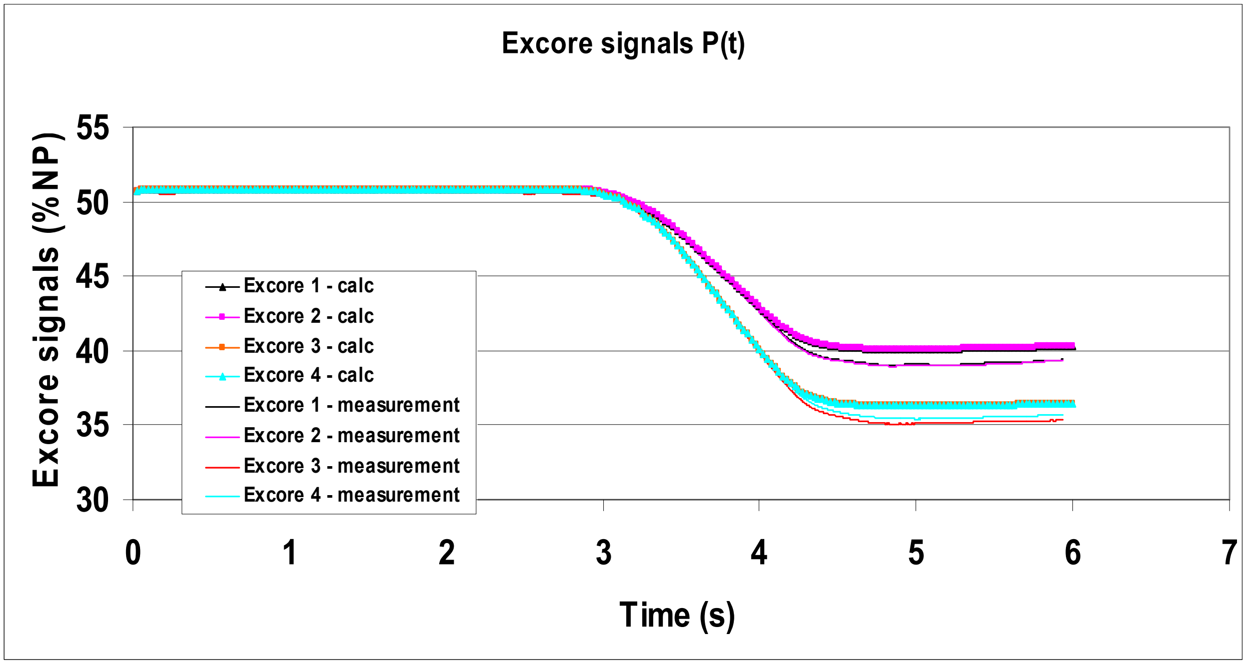


Figure 11.3-3: Results of Rod Drop Test 2 — 4.34 GWd/mtU, K6F10 (SD bank)



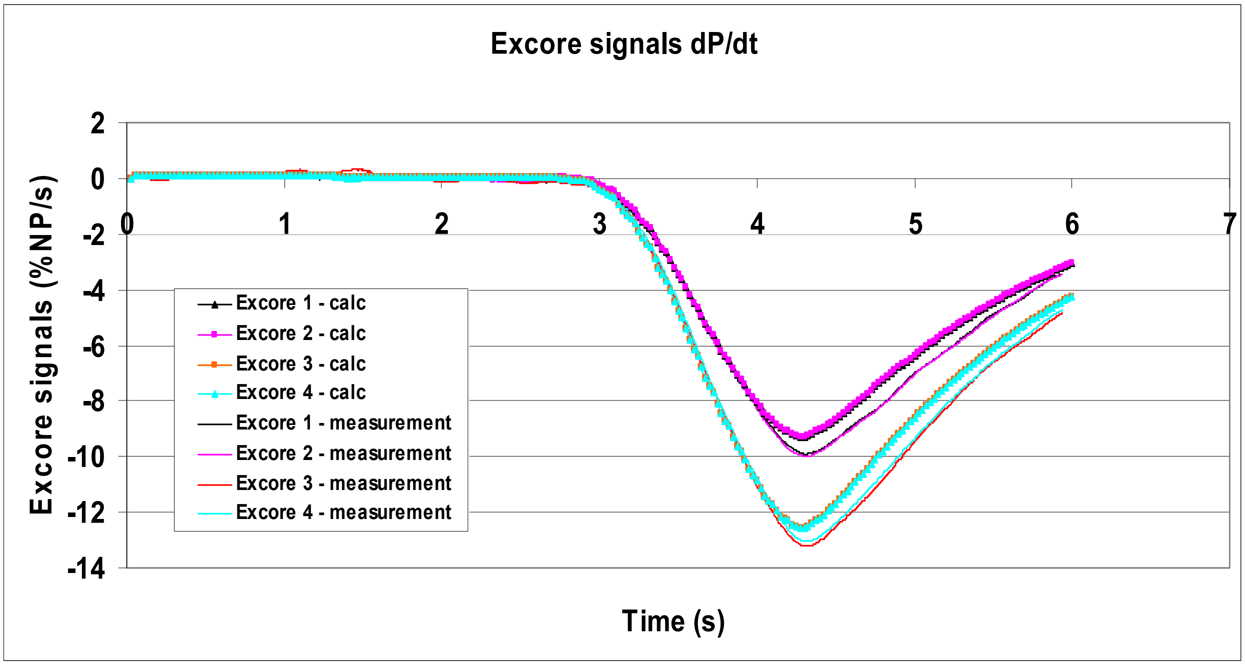
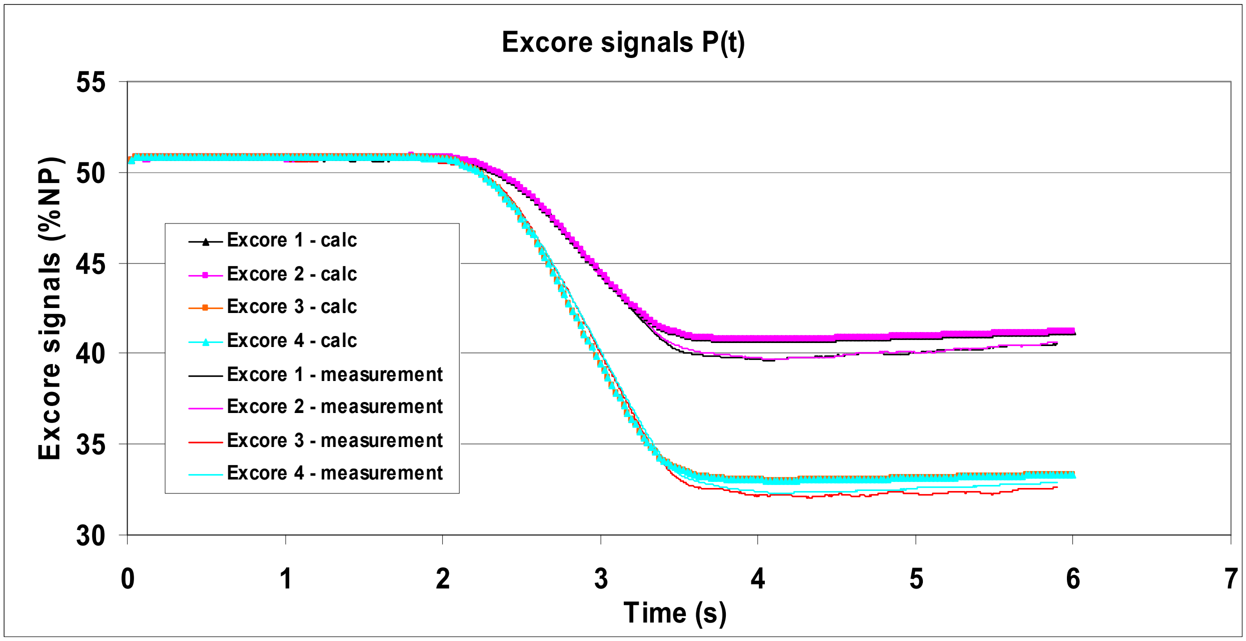


Figure 11.3-4: Results of Rod Drop Test 3 — 4.34 GWd/mtU, K4F12 (SC bank)



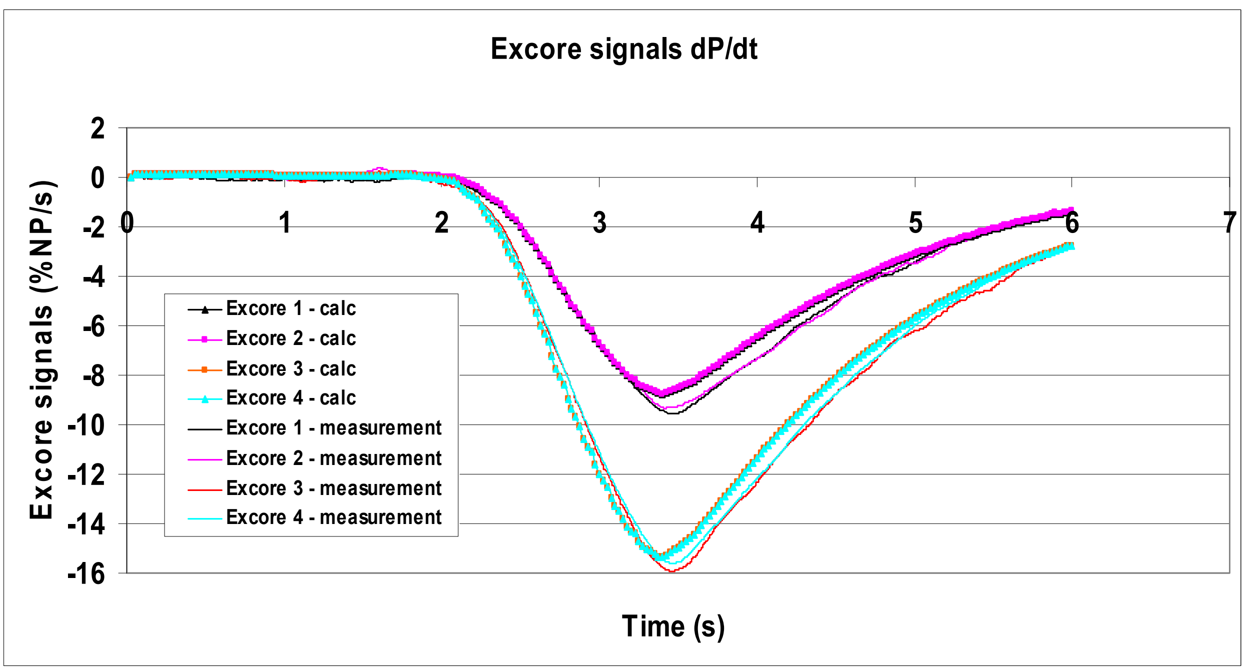
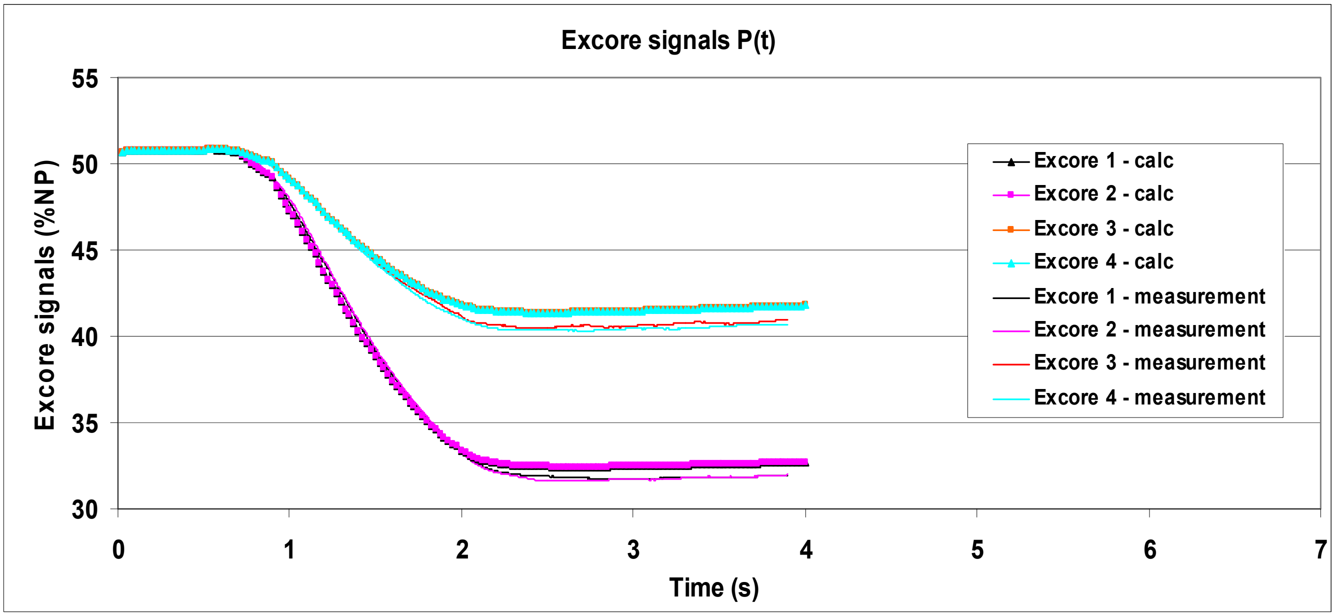


Figure 11.3-5: Results of Rod Drop Test 4 — 4.34 GWd/mtU, E5L11 (R bank)



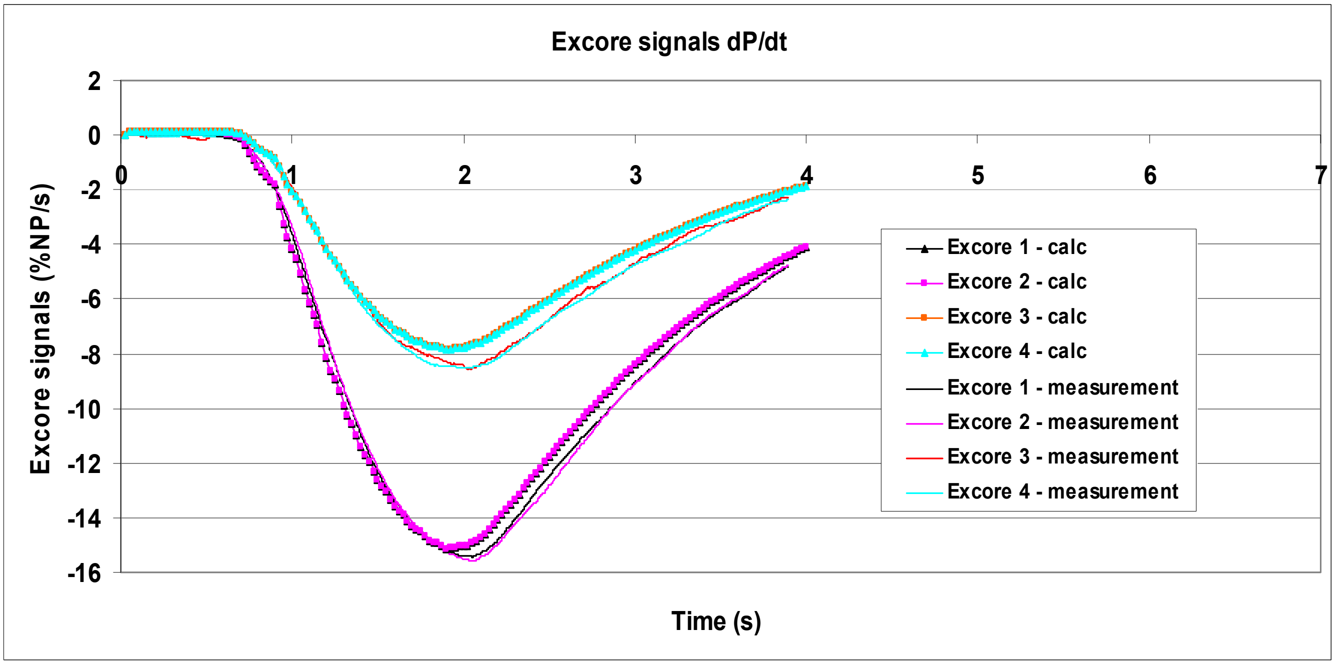
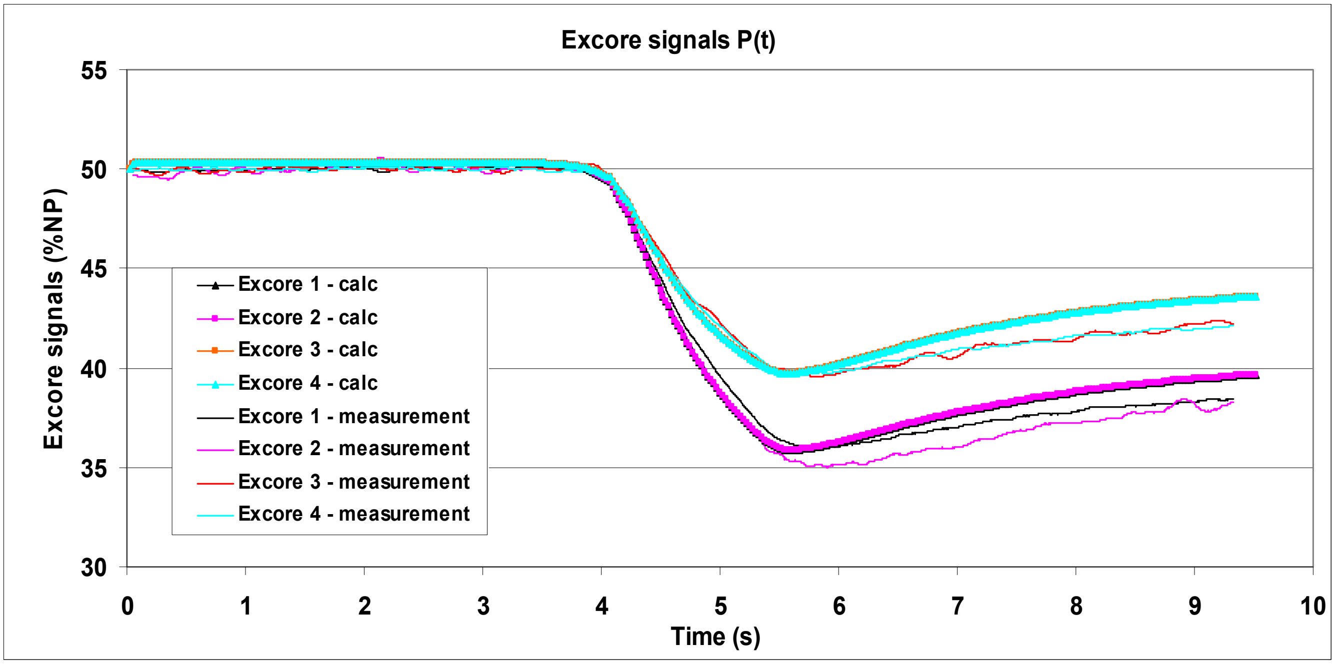


Figure 11.3-6: Results of Rod Drop Test 5 ─ 11.575 GWd/mtU, F6K10 (SD bank)



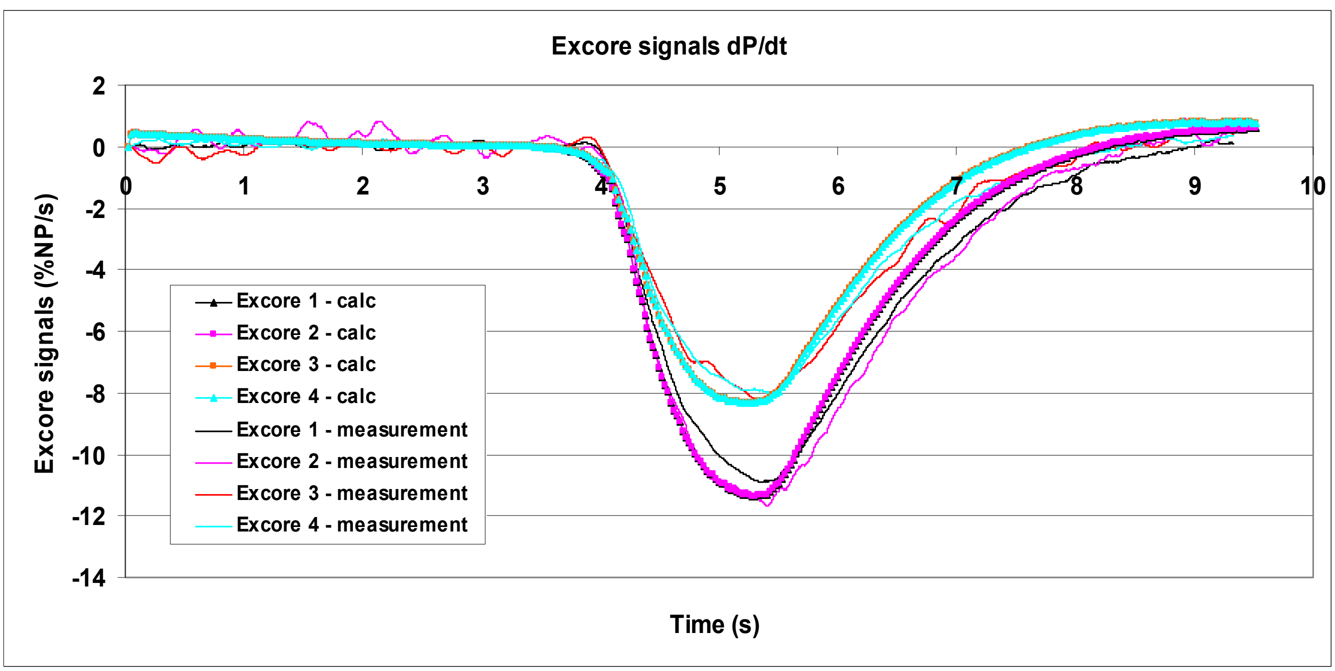
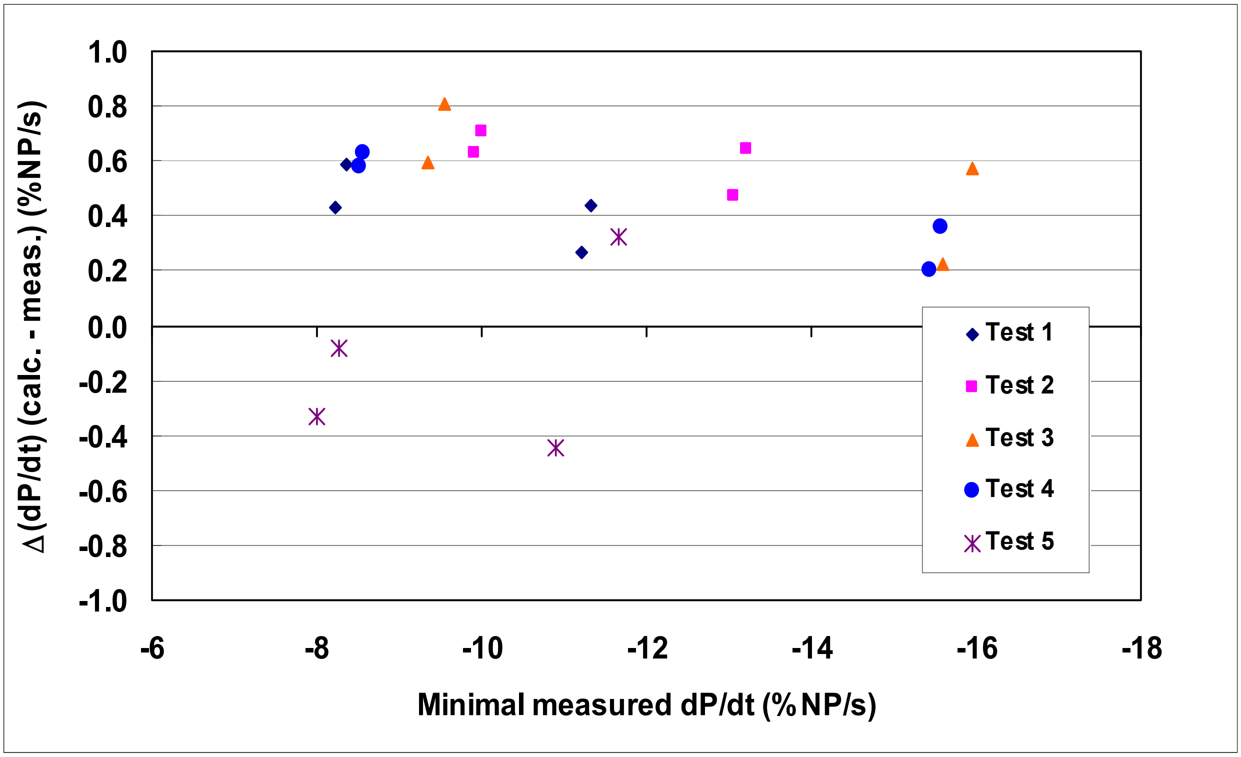


Figure 11.3-7: Results of Rod Drop Tests ─ Synthesis of Deviation on Minimal Derivative of the Nuclear Flux dP/dt



11.4 *References*

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11.4-2 H. Finnemann, H. Bauer, A. G. Galati, and R. Martinelli, "Results of LWR Core Transient Benchmarks," NEA/NSC/DOC(93)25, October 1993

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12.0 POWER DISTRIBUTION UNCERTAINTIES

12.1 *Introduction*

For licensing applications uncertainties need to be applied to local peaking factors such as $F_{\Delta H}$ and F_Q. Two types of peaking uncertainties are needed for ARCADIA® to support current AREVA methods for both $F_{\Delta H}$ and F_Q, an inferred uncertainty described in References 12.6-1 and 12.6-2 and a calculation uncertainty (Nuclear Reliability Factors) described in Reference 12.6-3.

The ability of ARCADIA® to provide inferred and predicted power distributions is dependent upon both local (pin to pin) and global (assembly to assembly) power predictions. ARCADIA® comparisons to measured fission rates for fuel pins in critical experiments and comparisons to higher order calculations are used to determine the local power component which is identical for both types of uncertainties. The local power comparisons and results are presented in Section 12.2.

Both types of uncertainties depend upon comparisons to measured data at commercial power plants to determine the global error term. The type of error is different for the inferred and calculated uncertainties because the inferred error is based upon the ability of the simulator to predict the powers in uninstrumented assemblies based on the measurements and the calculation uncertainty is based upon the ability to predict the measured value. The global component of the inferred uncertainty is calculated for each plant type and combined with the local uncertainty to obtain an inferred uncertainty in Section 12.3. The comparisons of ARTEMIS predictions to measured values and derivation of the calculational uncertainties are presented in Section 12.4. A summary of the estimated uncertainties is provided in Section 12.5.

The estimated uncertainties are 95/95 tolerance confidence limits. They are calculated assuming the populations for the error components are normally distributed which is referred to as a “Normal Uncertainty.” Monte Carlo simulations are performed on the

actual distributions to obtain a 95/95 tolerance/confidence limit which does not require the data to be normally distributed and is referred to as a “Non-Parametric Uncertainty”.

12.2 *Local Peaking Uncertainty*

The local peaking uncertainty component is dependent upon the ARCADIA® pin power prediction accuracy and is tested using two types of analyses. The first analysis compares predicted and measured pin fission rate results from six critical experiments to determine the accuracy of the APOLLO2-A methodology to calculate the local pin power distribution within a fuel assembly.

The second analysis compares ARTEMIS calculated pin power results to APOLLO2-A calculated results for several multi-assembly configurations. This comparison estimates the error of the ARTEMIS dehomogenization without and with burnup compared to an explicit pin model in APOLLO2-A. The ARTEMIS calculations utilize the same library generation process using APOLLO2-A calculations and the same ARTEMIS solution options as are used for core calculations contained in Section 10. The APOLLO2-A multi-assembly calculations directly model the flux gradients and spectral interaction between pins and neighboring assemblies. ARTEMIS reconstructs these details between the assemblies based on the dehomogenization methodology presented In Section 3.7. This analysis tests this methodology with twenty different multi-assembly problems.

12.2.1 Critical Core Configurations

Six critical experiments performed by the B&W Lynchburg Research Center as part of the DOE Gadolinia project (Reference 12.6-4) are used for the uncertainty analysis. These experiments contain UO_2 fuel with two enrichment zones, water holes and Gadolinia rods as described in Table 12.2.1-1. These experiments are some of the most recent experiments and are found to have a low measurement uncertainty and are sufficient to determine the accuracy of the APOLLO2-A to predict pin powers within the assembly with no burnup.

The calculated fission rates for the six critical experiments are compared to the measured fuel pin fission rates from each critical experiment to estimate the pin power uncertainty. These fuel pins represent one-eighth of the fuel assembly that is located in the center of the core. The first four of the critical experiments represent a 15x15 lattice of fuel pins and resemble the AREVA Mark B fuel assembly configuration. The last two experiments represent a CE 16x16 lattice with five large water holes per assembly occupying four fuel cell locations per water hole.

Figure 12.2.1-1 through Figure 12.2.1-6 show the fission rate distribution comparisons of the calculated and measured data for the six critical experiments. These fission rate distributions are relative to an average assembly fission rate of 1.0 for the center assembly. These critical geometries are representative of typical assemblies that could exist in a power reactor and show the power distribution within an assembly. The results are excellent. No biases are observed around water holes or poisons.

The percent differences for pin powers greater than **[ ]** are used to calculate the mean and standard deviation for each experiment. The measurement uncertainty for the local pin power distributions is obtained for each critical experiment. The calculated variance is estimated by subtracting the measured variance from the observed variance for each experiment. The resultant calculated standard deviations for each experiment are between 0.5 and 0.8 and no significant differences are noted between cores with or without Gadolinia rods. The calculated error for each set is combined to obtain the total estimated calculational error. These results are shown in Table 12.2.1-2.

12.2.2 Multi-Assembly Calculations with APOLLO2-A and ARTEMIS

Twenty multi-assembly depletion problems are analyzed with APOLLO2-A and ARTEMIS. The multi-assembly problems consist of two different fuel assembly types loaded in a checkerboard 4 x 1/4 fuel assembly pattern. The cross section information for the ARTEMIS calculations is obtained from single-assembly APOLLO2-A calculations. A list of the various multi-assembly problems is provided in Table

12.2.2-1. The problems listed include a variety of fuel assembly designs taken from actual or planned core designs. Variations between assemblies include enrichment loadings, burnable poison loadings, and rod insertion. The initial burnup for an assembly is generated in a previous multi-assembly configuration. Each of the twenty multi-assembly problems is depleted at fixed fuel and moderator temperatures for about 20 GWd/mtU and fresh fuel is inserted in two or three of the locations to initialize the problem. The precise initial assembly burnup is smaller or larger than 20 GWd/mtU depending upon the integrated power of the assembly during the previous depletion. Once initialized and depleted, the ratio of the pin power to the average assembly pin power throughout the depletion from ARTEMIS is compared to the APOLLO2-A value for each pin.

The multi-assembly results are used to define the errors of using single assembly APOLLO2-A nuclear data in ARTEMIS with the dehomogenization model relative to a fine mesh, higher order calculation in APOLLO2-A.

Table12.2.2-2 provides a summary of the results of the local pin powers from each multi-assembly problem. All power producing pins in unrodded assemblies with relative powers > **[ ]** are considered in the statistical results including Gadolinia pins. The maximum peak to peak relative difference for all the problems is **[ ]**. The standard deviation of the local pin powers is at or below **[ ]** for each of these cases. The mean and standard deviation for the entire set of cases are **[ ]** respectively with **[ ]**. The large difference in set 14 of **[ ]** is in a Gad rod at 8 GWd/mtU that is near the assembly with a control rod inserted during the depletion. This difference is a misprediction in time since at 20 GWd/mtU, the Gad poison is depleted and the error reduces to **[ ]**. This condition is not expected since US plants operate with the rods almost fully withdrawn. This data set is conservatively included in the statistics even though the conditions for this data are atypical. Pin power relative percent differences are provided for test sets 4 and 9 at 0.1, 10.0, and 20.0 GWd/mtU in Figure 12.2.2-1 through Figure 12.2.2-6.

Some of the peak to peak differences are significantly larger than the standard deviation would imply. In these cases the peak is in the corner pin or on the periphery of the assembly. To be conservative in the uncertainty determination, the statistics are taken from the peripheral pins which tend to have higher differences. The mean and standard deviation for the peripheral pins are **[ ]** and **[ ]**, respectively with **[ ]**

The multi-assembly benchmark demonstrates the ability of ARTEMIS to predict pin powers with burnup effects using the coarse mesh solution (4 nodes per assembly) with its dehomogenization model.

12.2.3 Local Peaking Uncertainty

The comparison to the critical experiments provides the error of APOLLO2-A when predicting intra-assembly peaking, while the multi-assembly benchmark calculations provide any additional error which occurs due to the flux/power gradients and depletion effects that occur in a PWR core with ARTEMIS compared to APOLLO2-A. The frequency plots are shown in Figure 12.2.3-1 and Figure 12.2.3-2 for the critical experiments and the Multi-Assembly results, respectively. No unusual behavior is observed in these figures. The data for the critical experiments is tested for normality using the Chi^2 test and the hypothesis that the data is normally distributed is not rejected. This test verifies that the assumption of normality used in the statistical removal of the measurement error in Section 12.2.1 is valid. The uncertainties calculated in Sections 12.3 and 12.4 use the local peaking information as inputs to the Normal Uncertainty and Non-Parametric Uncertainty which addresses both normal and non-normal distributions.

12.3 *Inferred Power Distribution Uncertainty Analyses*

The methodology used to derive inferred relative power distribution uncertainties is essentially the same as the methodology described in Reference 12.6-1 and Reference 12.6-2. For plant monitoring, peaking information is needed for all locations in the core,

however, not all locations in the core have detectors. To obtain the “measured” values in uninstrumented locations, a core simulator and core monitoring algorithms are used to infer the power in uninstrumented locations using both the measured and predicted values. Hence, the inferred uncertainty includes the effects of both calculated and measured powers and results in an uncertainty that can be compared to the measurement system uncertainty. This section presents the inferred uncertainty results with ARCADIA® for the different measurement systems used by AREVA.

For a given parameter of interest, e.g., $F_{\Delta H}$ or F_Q, the methodology estimates the error of the power in uninstrumented assembly locations and is summarized as follows:

1. For a given measured map of signals for the core, the power distribution is constructed with all available operable detectors. Values in the instrumented locations represent the “measured” or reference values.

2. For each detector location with measured axial signals, the signals for this detector location are assumed not to exist and the power distribution is reconstructed without this location. This is similar to setting the signal to inoperable or “failed”. The calculated value in the “failed” location is called the “inferred” value. This step is repeated for each detector location. Thus for a given map with N detector measurements, N relative difference values (inferred minus measured) are generated.

3. This process is repeated for multiple burnup points throughout a cycle, for multiple cycles, and multiple plants where available.

4. The cumulative data base forms the basis for the measured global uncertainty that is combined with the local calculational uncertainties to obtain the overall system uncertainty for the measurement system.

The inferred uncertainties for the power distribution peaking factors $F_{\Delta H}$ and F_Q are derived for each of 3 different incore measurement systems. Data reduction and

statistical treatment techniques are used to derive one-sided 95/95 relative uncertainties. The sampling techniques used in this analysis are:

- All pin powers > [ ] from critical experiments (excludes low powered Gad Pins).
- All pin powers > [ ] from the 4 by 1/4 multi-assembly calculations
- Relative assembly powers > [ ] for the assembly power distribution uncertainty component for $F_{\Delta H}$.
- Relative nodal powers > [ ] in assemblies w/ relative assembly power > [ ] for the nodal power distribution uncertainty component for F_Q.

The minimum threshold is used because the uncertainty is applied to the core limiting values which are significantly higher than these excluded values.

The three measurement systems evaluated are the INPAX-W system, the INPAX-CE system (also known as INPAX-II), and the MEDIAN AMS. Data from operating plants that use these measurement systems are simulated with the ARCADIA® system of codes (see Section 10). The results of these simulations are then processed using the inferred uncertainty methodology to obtain the uncertainties for each system. These results are contained in the following sections.

12.3.1 INPAX- W Reconstruction Methodology

The INPAX-W system is designed for Westinghouse Plants using movable incore detectors. The methodology is essentially the same as the methodology described in Reference 12.6-2 and has been applied in the past to Reference 12.6-5. Plants S1, S2, A, and V1 are used for the uncertainty analysis for this system. The results for each cycle and plant are shown in Table 12.3.1-1. For $F_{\Delta H}$ the mean and standard deviation for the entire sample are [ ], respectively, with [ ]. For F_Q the mean and standard deviation for the entire sample are [ ], respectively with [ ]. The reconstruction uncertainty is combined with the local uncertainty components from Section 12.2 assuming both normality and

non-parametric distributions to obtain estimations of the combined uncertainties. The combined frequency distributions are shown in Figure 12.3.1-1 and Figure 12.3.1-2 for the global peaking component of the $F_{\Delta H}$ and F_Q uncertainties, respectively. No atypical behavior is seen in these figures.

The global uncertainty is combined with the local uncertainty components from Section 12.2 to estimate the Normal Uncertainty and Non-Parametric Uncertainty and are shown in Table 12.3.1-2 and 12.3.1-3 for $F_{\Delta H}$ and F_Q, respectively. Either inferred power distribution uncertainty simulation is less than the typical measurement system uncertainty for $F_{\Delta H}$ and F_Q of 1.04 and 1.05, respectively.

12.3.2 INPAX-CE Reconstruction Methodology

The INPAX-CE system is designed for Combustion Engineering Plants using fixed incore detectors. Due to the nature of the fixed incore detector system additional components of the total uncertainties need to be evaluated. The methodology is essentially the same as the methodology described in Reference 12.6-1 and has been applied in the past to Reference 12.6-5. For the $F_{\Delta H}$ (F_R is the label of this term for CE plants) and F_Q uncertainty analyses, these values are equivalent to the 2 equations shown below:

$F_{\Delta H}$ = FSA * FR * FL

F_Q = FSA * FR * FZ * FL

Where

FSA = Average relative segment power

FR = Ratio of assembly relative power to average relative power of the detector segments

FZ = Ratio of the peak planar power in an assembly to the assembly power

FL = Local peaking factor (from Section 12.2)

The data from Plant C is used to derive the FSA component of the uncertainty analysis for this system. The results for each cycle are shown in Table 12.3.2-1. The mean and standard deviation for the entire sample are [ ], respectively with [ ].

More detailed axial information than is available from the 4 axial incore values is needed to estimate the error terms for FR and FZ terms. Plants S1, S2, and A which have moveable detector traces are used for the FR and FZ components of the uncertainty analysis for this system. The FR and FZ uncertainty components are calculated as follows:

1. For each operable detector location, the "true" FR and FZ values are calculated using all (60) axial measurement points.

2. For each operable detector location fixed incore detector signals are simulated by integrating the (60) axial measurement points over the equivalent (4) fixed incore detector heights.

3. Using the simulated fixed incore detector signals from step 2, "derived" FR and FZ values are calculated per the INPAX-CE reconstruction methodology. Thus for a given map with N operable detectors, N relative difference values (derived minus true) are generated.

The results for each cycle and plant are shown in Table 12.3.2-2. For FR the mean and standard deviation for the entire sample are [ ], respectively with [ ]. For FZ the mean and standard deviation for the entire sample are [ ], respectively with [ ]. The combined frequency distributions for FSA, FR, and FZ are shown in Figure 12.3.2-1, Figure 12.3.2-2, and Figure 12.3.2-3, respectively, for the global peaking component of the F_R and F_Q uncertainties, respectively. No atypical behavior is seen in these figures.

The global reconstruction uncertainty is combined with the local uncertainty components from Section 12.2 to estimate the Normal Uncertainty and Non-Parametric Uncertainty and are shown in Tables 12.3.2-3 and 12.3.2-4 for F_R and F_Q, respectively. Either inferred power distribution uncertainty simulation is less than the typical measurement system uncertainty for F_R and F_Q of 1.06 and 1.07, respectively.

12.3.3 MEDIAN AMS Reconstruction Methodology

The MEDIAN (**ME**asured **D**ependent **I**nterpolation **A**lgorithm using **N**EM) AMS (Aeroball Measurement System) is being used in German reactors and will be implemented in the US EPR plants. This inferred power distribution uncertainty is documented in Reference 12.6-6. Plants G1 and G2 are used for the uncertainty analysis for this system. The significant difference in this uncertainty analysis compared to the previous results presented in Reference 12.6-6 is that the MEDIAN AMS is run with ARCADIA and uses four nodes per assembly. The results for each cycle and plant are shown in Table 12.3.3-1. For $F_{\Delta H}$ the mean and standard deviation for the entire sample are **[ ]**, respectively with **[ ]**. For F_Q the mean and standard deviation for the entire sample are **[ ]**, respectively with **[ ]**. The combined frequency distributions for the global components for $F_{\Delta H}$ and F_Q are shown in Figure 12.3.3-1 and Figure 12.3.3-2, respectively, for the global peaking component of the $F_{\Delta H}$ and F_Q uncertainties, respectively. No atypical behavior is seen in these figures.

The inferred component from above is combined with the local uncertainty components from Section 12.2 to estimate the Normal Uncertainty and Non-Parametric Uncertainty and are shown in Tables 12.3.3-2 and 12.3.3-3 for $F_{\Delta H}$ and F_Q, respectively. Either inferred power distribution uncertainty simulation is less than the inferred power distribution uncertainty for $F_{\Delta H}$ and F_Q of **[ ]**, respectively, which are reported in Reference 12.6-6. **[ ]**

[

]

12.4 Calculated Power Distribution Uncertainty Analyses (Nuclear Reliability Factors)

The Nuclear Reliability Factors (NRF) for ARCADIA® are determined for the hot pin power ($F_{\Delta H}$) and the hot pellet power (F_Q). Each NRF is composed of two error terms, one for the global power prediction and the other for the local prediction (Section 12.2). The ARTEMIS core global power distributions are compared to measured data to determine the global error term. The results of the global comparisons presented in this section are combined with the uncertainties defined in Section 12.2 to derive the NRFs for the ARCADIA® system.

All plants modeled in Section 10 are used to obtain the global calculational uncertainties. This database is representative of the PWR cores that AREVA provides licensing analyses and is sufficient to derive NRFs for ARCADIA®. In the following sections, the statistical results (Section 12.4.1) are presented for the global power distributions and the NRFs (Section 12.4.2) are calculated for ARCADIA®.

12.4.1 Global Results

The sample mean and standard deviation of the relative difference between predicted and reference can be calculated for each of the comparisons by using the following formulas.

$a = p/m - 1$

where p = the predicted value,

m = the reference value, and

a = the relative difference of predicted to measured value where the value "a" could be either radial, peak, or local pin power.

Alternatively, the results could also be compiled as an absolute difference as in the following equation.

$$a = p - m$$

where a in this case is the difference of the predicted to the reference value

In general, statistical information is computed for a. A frequency plot is used as a means of examining the database. The measured and predicted reaction rates are compared to estimate the global uncertainty in the powers. For cores with fixed incore detectors, the four detector locations with the highest predicted powers for each of the instrumented assembly locations are used for the peak statistic. The four highest mid-grid values are used to determine the peak values for detector systems that contain a more continuous axial measurement. The statistical summaries for each of the analyzed plant cycles for the global uncertainties are shown in Table 12.4.1-1 and Table 12.4.1-2 for the assembly radial powers and peak assembly powers, respectively. For the radial the mean and standard deviation for the entire sample are **[**

], respectively with **[** **]**.

The statistics for the peak comparisons require some additional background information. The grids are homogenized in APOLLO2-A for the ARTEMIS cross sections and do not model the grid depressions which will underpredict the peak when the measured data includes the grid depressions. Note in Table 12.4.1-2 that ARTEMIS does underpredict the peak by about **[** **]** as illustrated by the mean values for W plant types and the G plant types. Note that the G1 plant has a **[** **]** bias. The G1 plant does not currently use this uncertainty method but if it did, either the reason for the higher bias would need to be resolved or a higher grid bias would be applied. The data from fixed incore detectors which do not measure the flux depressions do not have a

significant bias. Since the calculation is augmented by a grid factor when using these uncertainties, the grid effect can be removed. Plant B and Plant G2 Cycles 1 and 2 contain fuel that have predominantly Inconel grids in these cycles. Inconel grids cause significantly larger grid depressions and are no longer used; hence, these data are not included in the peak statistics. The mean and standard deviation for the peak comparisons for this sample are [ ], respectively with [ ] for the data where the grid bias is removed from each plant.

The frequency distributions are shown for the radial and peak comparisons in Figure 12.4.1-1 and Figure 12.4.1-2. No atypical behavior is seen in these distributions.

12.4.2 NRF Determination

The NRF is calculated with both normal assumptions and with non-parametric methods. The most conservative of the two will be used as the uncertainty. The uncertainty is defined as a one-sided 95/95 tolerance/confidence limit. Discussions are given below for the NRFs for $F_{\Delta H}$ and F_Q.

The NRFs for $F_{\Delta H}$ and F_Q are determined from three components representing the global and local peaking variations. The two local components are described in Section 12.2. The reference value for the global power distributions is the measured data. A Monte Carlo method is utilized to combine the uncertainties, and the non-parametric tolerance method from Reference12.6-7 is used with the Monte Carlo simulation to calculate the NRF.

The Monte Carlo simulation randomly samples the data from each of the three components of the error terms for both the predicted value and reference value. These three components are the global assembly values and the two local components. The three predicted values are multiplied together to simulate an actual ARCADIA® calculation (predicted). Similarly, the resultant reference value is obtained and divided by the predicted value. This result is the multiplier to apply to the prediction to obtain the reference value. Satterthwaite's approximation is used to determine the equivalent

degrees of freedom for the number of samples for the Monte Carlo simulation. For this sample size the non-parametric tolerance limit equation is used to determine the point on the simulated distribution that represents the one-sided 95%/95% statistical tolerance/confidence limit for when ARCADIA® underpredicts the reference value.

The calculated uncertainties are combined with the local uncertainty components from Section 12.2 to estimate the Normal Uncertainty and Non-Parametric Uncertainty and are shown in Table 12.4.1-3 and 12.4.1-4 for $F_{\Delta H}$ and F_Q, respectively. The largest NRFs for either method for $F_{\Delta H}$ and F_Q are **[ ]**, respectively. These values are less than the values of 1.038 and 1.048 for $F_{\Delta H}$ and F_Q from Reference 12.6-7, respectively, that are currently in use.

12.5 *Power Distribution Uncertainty Summary*

The uncertainties for ARCADIA® are calculated for both the inferred power distribution undertainties and calculational uncertainties and are summarized in Table 12.5-1 with both the ARCADIA® calculated values and the current licensing values. As shown in the table, all the calculated values for ARCADIA® are less than the values used for the criteria.

12.6 *References*

12.6-1 "Exxon Nuclear Analysis of Power Distribution Measurement Uncertainty for St. Lucie Unit 1", XN-NF-83-01(P)

12.6-2 "Power Distribution Measurement Uncertainty For INPAX-W in Westinghouse Plants," EMF-93-164(P)(A)

12.6-3 H. A. Hassan, et al., "Power Peaking Nuclear Reliability Factors," BAW-10119P, Babcock & Wilcox, Lynchburg, Virginia, June 1977.

12.6-4 L. W. Newman et al., "Urania Gadolinia: Nuclear Model Development and Critical Experiment Benchmark," DOE/ET/34212-41, BAW-1810, April 1984.

12.6-5 "Reactor Analysis System for PWRs", EMF-96-029(P)(A)

12.6-6 "Incore Trip Setpoint and Transient Methodology for the U.S. EPR Topical Report", ANP-10287P-A

12.6-7 G. H. Hobson et al, "NEMO—Nodal Expansion Method Optimized," BAW-10180-A, Rev. 1, B&W Fuel company, Lynchburg, Virginia, March 1993.

Table 12.2.1-1: Critical Core Configuration Description

Critical Core ID	Reference Core	Description
C1	C1	15x15, UO2 pin configuration, 2.46 wt % 235U
C5	C1	15x15, UO2 pin configuration with 12 Gd pins, 2.46 wt % 235U, 4.00 wt % Gd2O3 / 1.94 wt % 235U
C12	C12	15x15, UO2 pin configuration, 2.46 wt % 235U outer zone and 4.02 wt % 235U inner zone
C14	C12	15x15, UO2 pin configuration with 12 Gd pins, 4.00 wt % Gd2O3 / 1.94 wt % 235U, 2.46 wt % 235U outer zone and 4.02 wt % 235U inner zone
C18	C18	16x16 CE UO2 pin configuration, 2.46 wt% 235U outer zone and 4.02 wt % 235U inner zone
C20	C18	16x16 CE UO2 pin configuration with 16 Gd pins, 4.00 wt % Gd2O3 / 1.94 wt % 235U, 2.46 wt % 235U outer zone and 4.02 wt % 235U inner zone

Table 12.2.1-2: Summary of Results of Percent Difference: Observed =(Calc/Meas – 1)*100%

Core	Number of Samples	Observed Mean	Observed Deviation	Measured Deviation	Estimated Calculated Deviation
Non-Gad Cores					
Core 1	32				
Core 12	32				
Core 18	32				
All Non-Gad	96				
Core 5	29				
Core 14	29				
Core 20	29				
All Gad-Cores	87				
All Cores	**183**				

Table 12.2.2-1: Multi-Assembly Descriptions

Set #	Plant lattice* | wt% U^{235}+zone loaded BP or Gad Loading (wt%)	Initial BU	Plant lattice* | wt% U^{235}+zone loaded BP or Gad Loading	Initial BU
1	(3) B&W 15x15 | 4.78 8 Gad 8.0 and 12 Gad 3.0	0	(1) B&W 15x15 / 4.78 none	40±5
2	(2) B&W 15x15 |4.78 8 Gad 8.0 and 12 Gad 3.0	0	(2) B&W 15x15 / 4.78 none	20±5
3	(3) B&W 15x15 |4.78 8 Gad 8.0 and 12 Gad 3.0	0	(1) B&W 15x15 / 4.78 Control Rod in GT	0
4	(2) B&W 15x15 | 4.80 +16@4.50 16 2.00 w/o B_4C in GT	0	(2) B&W 15x15 / 4.78 none	0
6	(2) B&W 15x15 wet lattice |3.73 none	0	(2) B&W 15x15 / 4.78 8 Gad 8.0 and 12 Gad 3.0	0
7	(3) CE 14x14 | 4.50 +36@3.91 20 Gad 6.0	0	(1) CE 14x14 | 4.50 +36@3.91 none	40±5
8	(2) CE 14x14 | 4.50 +36@3.91 20 Gad 6.0	0	(2) CE 14x14 | 4.50 +36@3.91 none	20±5
9	(2) CE 14x14 | 4.50 +36@3.91 20 Gad 6.0	0	(2) CE 14x14 | 4.50 +36@3.91 none	40±5
10	(3) CE 14x14 | 4.50 +36@3.91 20 Gad 6.0	0	(1) CE 14x14 | 4.50 +36@3.91 Rod in GT	0
11	(2) EPR 17x17| 4.85+60@4.8+24@4.5 16 Gad 8.0 / 12 Gad 4.0	0	(2) EPR 17x17| 4.85 none	0
12	(2) EPR 17x17| 4.85+60@4.8+24@4.5 16 Gad 8.0 / 12 Gad 4.0	0	(2) EPR 17x17| 4.85 none	20±5
13	(2) EPR 17x17| 4.85+60@4.8+24@4.5 16 Gad 8.0 / 12 Gad 4.0	0	(2) EPR 17x17| 4.85 none	40±5
14	(3) EPR 17x17| 4.85+60@4.8+24@4.5 16 Gad 8.0 / 12 Gad 4.0	0	(1) EPR 17x17| 4.85 Control Rod in GT	0
15	(3) W 17x17 | 4.95 24 Gad 6.0 / 12 Gad 2.0	0	(1) W 17x17 | 4.95 none	40±5
16	(2) W 17x17 | 4.95 24 Gad 6.0 / 12 Gad 2.0	0	(2) W 17x17 | 4.95 none	20±5
17	(2) W 17x17 | 4.95 16 Gad 4.0 / 24 3.00 w/o B_4C in GT	0	(2) W 17x17 | 4.95 none	0
19	(2) W 15x15 | 4.30 16 Gad 10.0	0	(2) W 15x15 | 4.30 none	20±5
20	(2) Siemens18x18 | 3.80 12 Gad 7.0	0	(2) Siemens18x18 | 3.80 none	20±5
21	(2) EPR 17x17| 2.25 none	0	(2) EPR 17x17| 3.25 12 Gad 8.0 / 4 Gad 2.0	0
22	(2) EPR 17x17| 4.85+60@4.8+24@4.5 16 Gad 8.0 / 12 Gad 4.0	0	(2) EPR 17x17| 3.25 12 Gad 8.0 / 4 Gad 2.0	20±5

***(*x*) indicates the number of assemblies of this type in the 4 x ¼ problem**

Table 12.2.2-2: Multi-Assembly Results

Set #	Maximum Absolute Relative Difference at BOC (%)	Maximum Absolute Relative Difference Over Entire Depletion (%)	Maximum Absolute Relative Peak to Peak Difference Over Entire Depletion (%)	Standard Deviation of Relative Differences of Each Pin Over Entire Depletion (%)
1				
2				
3				
4				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
19				
20				
21				
22				

Table 12.3.1-1: Global Statistics for INPAX-W System

		$F_{\Delta H}$		F_Q	
Plant	Cycle	mean	s.d.	mean	s.d.
S1	12				
S1	13				
S1	14				
S1	12 to 14				
S2	12				
S2	13				
S2	14				
S2	12 to 14				
A	11				
A	12				
A	13				
A	14				
A	11 to 14				
V1	18				
V1	19				
V1	20				
V1	21				
V1	22				
V1	18 to 22				
Total	All				

Table 12.3.1-2: $F_{\Delta H}$ Summary Statistics for INPAX-W Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
Radial					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.3.1-3: F_Q Summary Statistics for INPAX-W Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
Peak					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.3.2-1: FSA Statistics for INPAX-CE Incore Monitoring System

		FSA	
Plant	Cycle	mean	s.d.
C	14		
C	15		
C	16		
C	17		
C	18		
C	14 to 18		

Table 12.3.2-2: FR and FZ Statistics for INPAX-CE Incore Monitoring System

		FR		FZ	
Plant	Cycle	mean	s.d.	mean	s.d.
S1	12				
S1	13				
S1	14				
S1	12 to 14				
S2	12				
S2	13				
S2	14				
S2	12 to 14				
A	11				
A	12				
A	13				
A	14				
A	11 to 14				
Total	All				

Table 12.3.2-3: $F_{\Delta H}$ (F_R) Summary Statistics for INPAX-CE Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
FSA					
FR					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.3.2-4: F_Q Summary Statistics for INPAX-CE Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
FSA					
FR					
FZ					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.3.3-1: Statistics for MEDIAN AMS Incore Monitoring System

		$F_{\Delta H}$		F_Q	
Plant	Cycle	mean	s.d.	mean	s.d.
G1	26				
G1	27				
G1	28				
G1	29				
G1	30				
G1	26 to 30				
G2	1				
G2	2				
G2	3				
G2	4				
G2	5				
G2	1 to 5				
Total	All				

Table 12.3.3-2: $F_{\Delta H}$ Summary Statistics for MEDIAN Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals Colorsets Radial Normal Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.3.3-3: F_Q Summary Statistics for MEDIAN Incore Monitoring System

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals Colorsets Peak Normal Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction).

Table 12.4.1-1: Global Radial Statistics

		RADIAL	
Plant	Cycle	mean	s.d.
S1	12		
S1	13		
S1	14		
S1	12 to 14		
S2	12		
S2	13		
S2	14		
S2	12 to 14		
A	11		
A	12		
A	13		
A	14		
A	11 to 14		
B	1		
T1	12		
T1	13		
T1	14		
T1	15		
T1	12 to 15		
C	14		
C	15		
C	16		
C	17		
C	18		
C	14 to 18		
G1	26		
G1	27		
G1	28		
G1	29		
G1	30		
G1	26 to 30		
G2	1		
G2	2		
G2	3		
G2	4		
G2	5		
G2	1 to 5		
V1	18		
V1	19		
V1	20		
V1	21		
V1	22		
V1	18 to 22		
ALL	ALL		

Table 12.4.1-2: Global Peak Statistics

		PEAK	
Plant	Cycle	mean	s.d.
S1	12		
S1	13		
S1	14		
S1	12 to 14		
S2	12		
S2	13		
S2	14		
S2	12 to 14		
A	11		
A	12		
A	13		
A	14		
A	11 to 14		
T1	12		
T1	13		
T1	14		
T1	15		
T1	12 to 15		
C	14		
C	15		
C	16		
C	17		
C	18		
C	14 to 18		
G1	26		
G1	27		
G1	28		
G1	29		
G1	30		
G1	26 to 30		
G2	3		
G2	4		
G2	5		
G2	3 to 5		
V1	18		
V1	19		
V1	20		
V1	21		
V1	22		
V1	18 to 22		

Table 12.4.1-3: Summary $F_{\Delta H}$ Statistics

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
Radial					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction)

Table 12.4.1-4: Summary F_Q Statistics

	mean*	standard deviation	# of points	degrees of freedom	uncertainty %
Criticals					
Colorsets					
Peak					
Normal					
Non Parametric					

* For normal analysis, bias is conservatively ignored if mean is > 0.0 (overprediction

Table 12.5-1: Power Distribution Uncertainty Summary

Type of Uncertainty	$F_{\Delta H}$ (F_R for INPAX-CE)		F_Q	
	Estimated*	Criteria	Estimated*	Criteria
Inferred INPAX-W				
Inferred INPAX-CE				
Inferred Median AMS				
Calculational				

*Uncertainties have been rounded up to the digits displayed.

Figure 12.2.1-1: Core 1 Fission Rate Comparison

[ ]

Figure 12.2.1-2: Core 5 Fission Rate Comparison

[ ]

Figure 12.2.1-3: Core 12 Fission Rate Comparison

[ ]

Figure 12.2.1-4: Core 14 Fission Rate Comparison

Figure 12.2.1-5: Core 18 Fission Rate Comparison

[ ]

Figure 12.2.1-6: Core 20 Fission Rate Comparison

[ ]

Figure 12.2.2-1: Set 4 at 0.1 GWd/mtU

[ ]

Figure 12.2.2-2: Set 4 at 10.0 GWd/mtU

[ ]

Figure 12.2.2-3: Set 4 at 20.0 GWd/mtU

[ ]

Figure 12.2.2-4: Set 9 at 0.1 GWd/mtU

Figure 12.2.2-5: Set 9 at 10.0 GWd/mtU

[ ]

Figure 12.2.2-6: Set 9 at 20.0 GWd/mtU

Figure 12.2.3-1: Critical Experiments Frequency Distribution versus Normal Distribution

[ ]

Figure 12.2.3-2: Multi-Assembly Problem Frequency Distribution versus Normal Distribution

Figure 12.3.1-1: INPAX-W Radial Frequency Distribution versus Normal Distribution

[ ]

Figure 12.3.1-2: INPAX-W Peak Frequency Distribution versus Normal Distribution

[ ]

Figure 12.3.2-1: INPAX-CE FSA Frequency Distribution versus Normal Distribution

[ ]

Figure 12.3.2-2: INPAX-CE FR Frequency Distribution versus Normal Distribution

Figure 12.3.2-3: INPAX-CE FZ Frequency Distribution versus Normal Distribution

[ ]

Figure 12.3.3-1: MEDIAN Radial Frequency Distribution versus Normal Distribution

[ ]

Figure 12.3.3-2: MEDIAN Peak Frequency Distribution versus Normal Distribution

Figure 12.4.1-1: All Plants Radial Frequency Distribution versus Normal Distribution

[ ]

Figure 12.4.1-2: All Plants Peak Frequency Distribution versus Normal Distribution

13.0 SUMMARY AND QUALIFICATION METHOD

The purpose of this chapter is to summarize the results and provide the method that AREVA will use to implement future changes to the ARCADIA® methodology. The data in the previous chapters provided a qualification basis for the current ARCADIA® code package. Future modifications to the equations, algorithms, and methods in the ARCADIA® package can be used in licensing applications as long as certain criteria are met. This chapter provides the range of applicability of the benchmarks, methods qualification criteria and summary.

13.1 *Range of Applicability*

The chosen benchmarks in this topical include a wide range of benchmark comparisons at static and transient conditions to qualify ARCADIA® for Licensing applications. The benchmarks include the following:

- critical K and fission rate measurements from critical experiments,
- measured isotopic concentrations from spent fuel rods,
- measured parameters from commercial reactors at startup and operating conditions,
- reference analytical static and kinetic solutions, and
- measured power responses from dropped rod tests.

The benchmarks also include comparisons with diverse conditions. Plant simulations include comparisons to Westinghouse, Combustion Engineering, Babcock and Wilcox, Siemens, and Framatome designed reactors. These comparisons include the following conditions:

- Uranium fuel up to 5.0 weight percent U235
- PWR fuel geometries with square lattices with 4 cell water holes or smaller
- Includes boron as a fixed and removable burnable absorber in the fuel

- Gadolinium poison up to 10 weight percent (nominal) in U fuel
- Boron, AgInCd, and Hf as control rod poisons
- Structural Steel as fixed poisons in guide tubes or as fuel pin replacements

The benchmarks in this topical provide a basis to qualify the code for types of fuel that contain these materials.

13.2 *Methods and Qualification Criteria*

A list of methods qualification criteria that must be met by the results of future changes to the methods is defined and is discussed in this section.

The method to be used to qualify ARCADIA® for future changes is similar to the method presented in this and previous topical submittals. The neutronic code qualification is based on the ability of the code to predict several key neutronic parameters. The key parameters are critical boron or critical K-effective at HZP, critical boron or critical K-effective at HFP, individual bank rod worths, total rod worths, isothermal temperature coefficients, and power uncertainties. These predicted parameters will be compared to measured results and the differences will be compared to the criteria. If the results meet the criteria, then the methodology changes can be used for licensing applications.

The methods qualification criteria are listed in Table 13.2-1. These criteria are taken from Sections 10.5 and 12.0.

13.3 *Plant Applications*

AREVA will continue to monitor its methods with respect to current cycle designs for its licensing applications. Prior to licensing a new contract, AREVA will evaluate at least 3 cycles of data relative to these criteria prior to licensing the first cycle with AREVA fuel.

13.4 *Future Modifications*

A future method modification that meets the listed criteria in Table 13.2-1 will validate the method change. In the case of method changes that meet the criteria, AREVA will internally document the changes of the methods and the results. In this case, no notification will be sent to the NRC since there is no change to the uncertainties and their application. For example, if AREVA changes the ARTEMIS calculations from 2 energy groups to 4 energy groups or the number of energy groups used in APOLLO2-A is increased or decreased, AREVA intends to show that these changes meet the acceptance criteria and document internally.

For the situations where the uncertainties are lowered and/or a design change is outside the bounds of this submittal, a submittal via a Topical Report Revision, a License Amendment Request (LAR), or letter as appropriate will be sent to the NRC which includes the new design feature, a description of the benchmark results, and any impact on the current uncertainty factors. For example, if a new fuel design is beyond existing bounds of the analysis such as MOX fuel, additional benchmarks will be performed and a revision to the Topical would be submitted. In the case where AREVA desires to implement a lower uncertainty, AREVA would provide the results (which could be a reference to this topical and/or any new supporting data for the new uncertainty) and how AREVA intends to use the uncertainty as part of an LAR or a letter report to the NRC.

13.5 *Summary*

ARCADIA® is an integrated code package that includes a neutronic spectral/lattice code APOLLO2-A and a core simulator, ARTEMIS that has direct coupling with state-of-the-art thermal hydraulic and fuel rod models. The benchmarks of APOLLO2-A to measured results demonstrate that APOLLO2-A is capable of producing accurate results for pin powers, critical eigenvalues, and isotopic concentrations. ARTEMIS results for rod worths, critical boron

concentrations, isothermal temperature coefficients and peaking are compared to operating PWRs. The key ARCADIA® results are summarized in Table 13.5-1 and are an example of meeting the qualification method criteria outlined in this section. In addition, the coupling with the Thermal Hydraulic Module (COBRA-FLX) and the fuel rod model are verified with analytical results and are tested in the static and kinetics benchmarks with ARTEMIS. These results demonstrate that the ARCADIA® calculational model is an accurate tool for predicting both local and global core neutronic static and kinetic behavior.

ARCADIA® can be used to perform neutronic calculations for the reload designs of pressurized water reactors, to analyze reactivity and power distributions, and to make startup predictions. In addition, a qualification method is provided that defines the method that AREVA will use to qualify future method changes to ARCADIA®.

Table 13.2-1: Methods Qualification Criteria

Parameter- (% relative difference or difference between predicted and measured values)	Criteria
HFP Critical K-Effective	Within ±50 ppm or ±500 pcm
HZP Critical K-Effective	Within ±50 ppm or ±500 pcm
Single Bank Worths, %	within ±15% or ±100 pcm
Total Bank Worths, %	within ±10%*
HZP Isothermal Temperature Coefficient, pcm/^{o}F	within ±2.0
$F_{\Delta H}$ Calculation Uncertainty	$\leq$ 3.8%
F_Q Calculation Uncertainty	$\leq$ 4.8%
Inferred power distribution uncertainty for $F_{\Delta H}$ and F_Q	$\leq$ Power Distribution Uncertainty values from Technical Specifications

* Some plants have more restrictive criterion and would be verified prior to implementation.

Table 13.5-1: Methods Qualification Criteria

Parameter- (% relative difference or difference between predicted and measured values)	**Criteria**	**Results**
HFP Critical K-Effective	Within ±50 ppm or ±500 pcm	Max of 46 ppm for those values less than 50 ppm. For those ppm values >50 ppm, 483 pcm
HZP Critical K-Effective	Within ±50 ppm or ±500 pcm	All values within ±50 ppm error bars.
Single Bank Worths, %	within ±15% or ±100 pcm	14.5
Total Bank Worths, %	within ±10%	Maximum absolute difference 9.6%
HZP Isothermal Temperature Coefficient, pcm/°F	within ±2.0 pcm/°F	Maximum absolute difference 1.43 pcm/°F
$F_{\Delta H}$ Calculation Uncertainty	<3.8%	[
F_Q Calculation Uncertainty	<4.8%	
Inferred power distribution uncertainty for $F_{\Delta H}$ F_Q	Typical Westinghouse $F_{\Delta H} \leq 4\%$ $F_Q \leq 5\%$	
Inferred power distribution uncertainty for F_R F_Q	Typical CE Plant $F_R \leq 5\%$ $F_Q \leq 7\%$	
Inferred power distribution uncertainty for $F_{\Delta H}$ F_Q	Median AMS Plant $F_{\Delta H} \leq$ [ ] $F_Q \leq$	]

Appendix A

Table A 10.3.1-1: Plant A Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 1-14

Cycle	Measured (ppm)	Calculated (ppm)	Difference C-M (ppm)
1	1353	1342	-12
2	1764	1725	-40
3	1841	1816	-25
4	1718	1702	-17
5	1947	1952	5
6	1842	1804	-38
7	2224	2152	-72[a]
8	2206	2145	-61[a]
9	1997	1957	-40
10	1889	1850	-39
11	2090	2053	-36
12	2024	2036	13
13	2061	2061	0
14	2051	2064	13

[a]Using the ±500 pcm equivalent criteria for Cycles 7 and 8 results in limits of ±78 ppm and ±80 ppm, respectively.

Table A 10.3.1-2: Plant A Cycle 1 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	711	695	-16	-2.2
Control B	1371	1344	-27	-2.0
Control C	1012	974	-38	-3.8
Control D	477	471	-5	-1.2
Shutdown A	1177	1161	-16	-1.4
Shutdown B	1006	962	-43	-4.3
Shutdown C	468	463	-5	-1.1
Shutdown D	579	560	-18	-3.2
Total	6801	6632	-170	-2.5

Table A 10.3.1-3: Plant A Cycle 2 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	706	666	-40	-5.7
Control B	1223	1206	-17	-1.4
Control C	771	774	3	0.4
Control D	1049	1067	18	1.8
Shutdown A	1052	1040	-12	-1.2
Shutdown B	1044	1051	7	0.6
Shutdown C	439	410	-29	-6.6
Total	6283	6214	-69	-1.1

Table A 10.3.1-4: Plant A Cycle 3 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	382	345	-37	-9.6
Control B	1208	1205	-3	-0.3
Control C	656	649	-7	-1.1
Control D	1243	1260	17	1.4
Shutdown A	1373	1371	-3	-0.2
Shutdown B	785	792	7	0.9
Shutdown C	345	306	-39	-11.3
Total	5993	5928	-65	-1.1

Table A 10.3.1-5: Plant A Cycle 4 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	389	395	5	1.4
Control B	1359	1308	-51	-3.8
Control C	786	747	-38	-4.9
Control D	956	947	-8	-0.9
Shutdown A	1273	1263	-10	-0.8
Shutdown B	796	767	-29	-3.7
Shutdown C	341	309	-32	-9.4
Total	5899	5736	-164	-2.8

Table A 10.3.1-6: Plant A Cycle 5 Hot Zero Power individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	408	337	-71	-17.4
Control B	1397	1281	-115	-8.2
Control C	944	866	-78	-8.3
Control D	1324	1221	-103	-7.8
Shutdown A	985	882	-103	-10.5
Shutdown B	1032	955	-77	-7.4
Shutdown C	366	294	-72	-19.7
Total	6456	5836	-620	-9.6

Table A 10.3.1-7: Plant A Cycle 6 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	355	370	15	4.1
Control B	1315	1361	46	3.5
Control C	1110	1125	16	1.4
Control D	925	926	1	0.1
Shutdown A	981	1027	46	4.7
Shutdown B	766	776	11	1.4
Shutdown C	444	479	34	7.7
Total	5896	6063	167	2.8

Table A 10.3.1-8: Plant A Cycle 7 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	300	284	-16	-5.5
Control B	1443	1483	40	2.8
Control C	1047	980	-68	-6.5
Control D	1098	999	-99	-9.0
Shutdown A	1047	1028	-19	-1.8
Shutdown B	1072	1001	-71	-6.6
Shutdown C	359	379	20	5.4
Total	6366	6153	-213	-3.4

Table A 10.3.1-9: Plant A Cycle 8 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	249	225	-24	-9.5
Control B	1130	1174	44	3.9
Control C	966	956	-10	-1.0
Control D	1094	1091	-3	-0.3
Shutdown A	858	829	-28	-3.3
Shutdown B	1015	1032	17	1.7
Shutdown C	304	279	-26	-8.4
Total	5617	5587	-29	-0.5

Table A 10.3.1-10: Plant A Cycle 9 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	325	296	-30	-9.2
Control B	1198	1166	-31	-2.6
Control C	994	980	-13	-1.3
Control D	1038	1040	1	0.1
Shutdown A	909	880	-29	-3.1
Shutdown B	1026	997	-30	-2.9
Shutdown C	345	310	-34	-10.0
Total	5835	5669	-166	-2.8

Table A 10.3.1-11: Plant A Cycle 10 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	332	319	-14	-4.1
Control B	1426	1472	46	3.2
Control C	1109	1047	-62	-5.6
Control D	944	890	-53	-5.6
Shutdown A	924	931	7	0.8
Shutdown B	1172	1145	-27	-2.3
Shutdown C	247	242	-5	-2.2
Total	6154	6046	-108	-1.8

Table A 10.3.1-12: Plant A Cycle 11 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	505	557	52	10.3
Control B	1055	1071	17	1.6
Control C	909	953	44	4.8
Control D	872	1004	132	15.1
Shutdown A	944	1028	83	8.8
Shutdown B	859	865	6	0.7
Shutdown C	290	325	36	12.3
Total	5434	5802	369	6.8

Table A 10.3.1-13: Plant A Cycle 12 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	339	269	-69	-20.5
Control B	1331	1260	-71	-5.4
Control C	963	1033	71	7.4
Control D	1006	1030	24	2.4
Shutdown A	824	721	-104	-12.6
Shutdown B	1059	1213	154	14.5
Shutdown C	262	188	-74	-28.3
Total	5784	5714	-70	-1.2

Table A 10.3.1-14: Plant A Cycle 13 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	405	373	-32	-7.8
Control B	1117	1160	43	3.9
Control C	870	846	-25	-2.8
Control D	1072	1067	-6	-0.5
Shutdown A	1063	1036	-28	-2.6
Shutdown B	1006	999	-7	-0.7
Shutdown C	298	271	-27	-9.1
Total	5831	5751	-81	-1.4

Table A 10.3.1-15: Plant A Cycle 14 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
Control A	423	457	34	8.0
Control B	1071	1185	114	10.6
Control C	803	785	-17	-2.1
Control D	1006	1023	16	1.6
Shutdown A	950	1007	57	6.0
Shutdown B	1172	1173	1	0.1
Shutdown C	310	329	19	6.0
Total	5735	5959	224	3.9

Table A 10.3.1-16: Plant A Summary of Total Bank Worths

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
1	6801	6632	-170	-2.5
2	6283	6214	-69	-1.1
3	5993	5928	-65	-1.1
4	5899	5736	-164	-2.8
5	6456	5836	-620	-9.6
6	5896	6063	167	2.8
7	6366	6153	-213	-3.4
8	5617	5587	-29	-0.5
9	5835	5669	-166	-2.8
10	6154	6046	-108	-1.8
11	5434	5802	369	6.8
12	5784	5714	-70	-1.2
13	5831	5751	-81	-1.4
14	5735	5959	224	3.9

Table A 10.3.1-17: Plant A Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 1-14

Cycle	Measured (pcm/°F)	Calculated (pcm/°F)	Difference C-M (pcm/°F)
1	-1.56	-0.73	0.83
2	-0.84	-0.29	0.56
3	-0.54	0.25	0.79
4	-1.66	-0.95	0.72
5	1.21	1.99	0.78
6	-3.90	-3.25	0.65
7	-2.92	-2.14	0.78
8	-3.39	-2.70	0.69
9	-5.60	-4.72	0.88
10	-6.08	-5.22	0.86
11	-4.99	-3.97	1.02
12	-5.93	-5.22	0.71
13	-5.20	-4.50	0.70
14	-4.32	-3.39	0.93

Figure A 10.2.1-1: Plant A Fuel Assembly Guide Tube Configuration

3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	1	3	3	1	3	3	1	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	1	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	2	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	1	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	1	3	3	1	3	3	1	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

- 1 Guide tube
- 2 Guide tube with instrument
- 3 UO_2 Rod

Figure A 10.4.1-1: Plant A Cycle 1 Critical Boron Concentration vs. Burnup

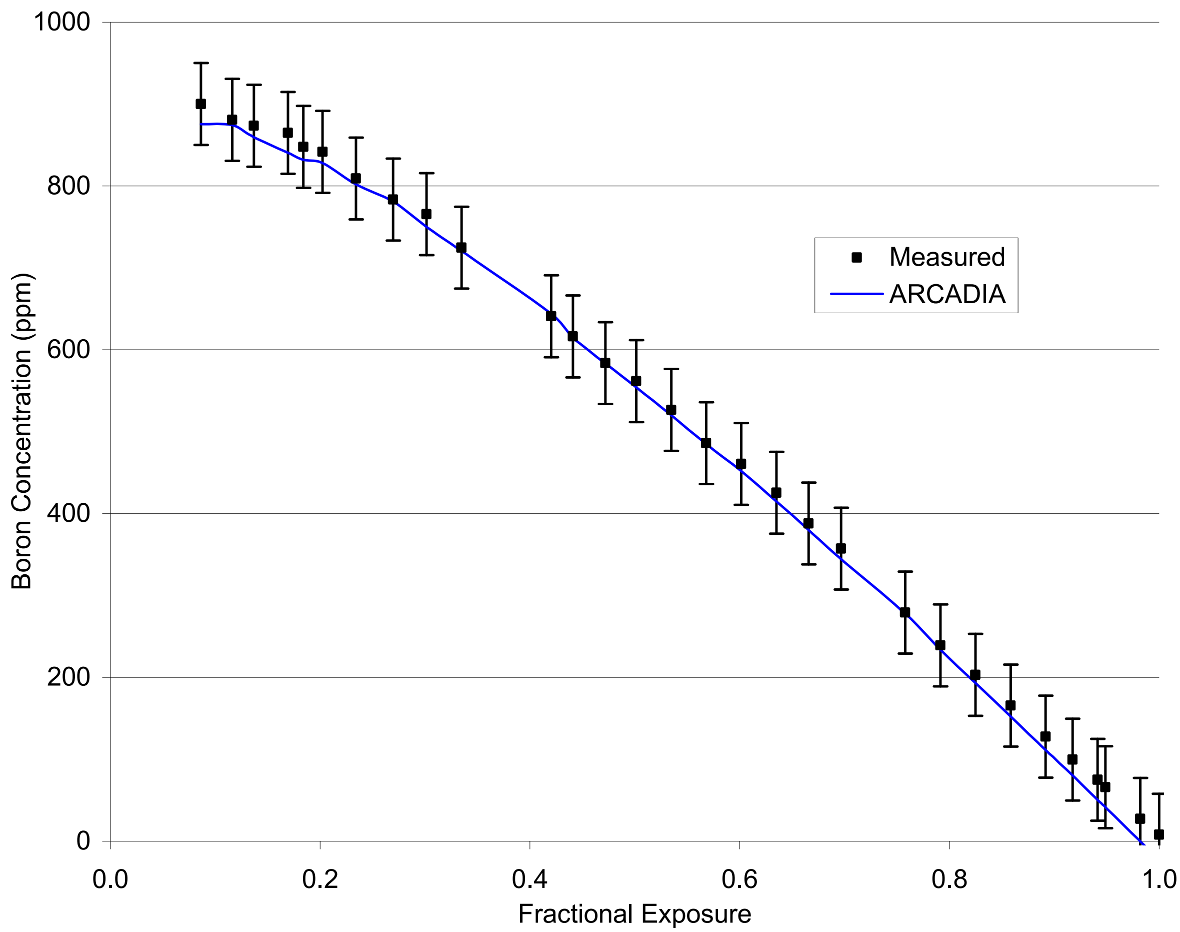


Figure A 10.4.1-2: Plant A Cycle 2 Critical Boron Concentration vs. Burnup

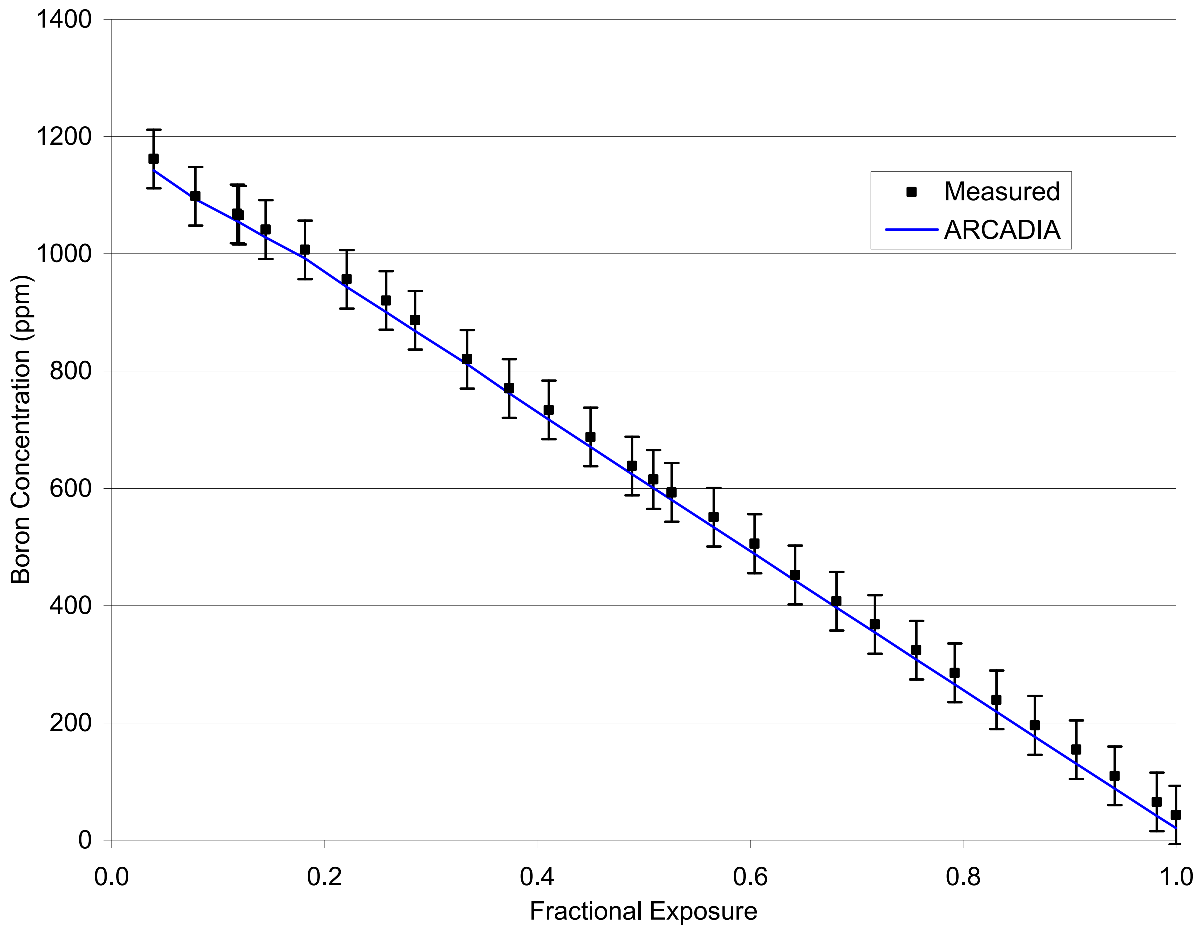


Figure A 10.4.1-3: Plant A Cycle 3 Critical Boron Concentration vs. Burnup

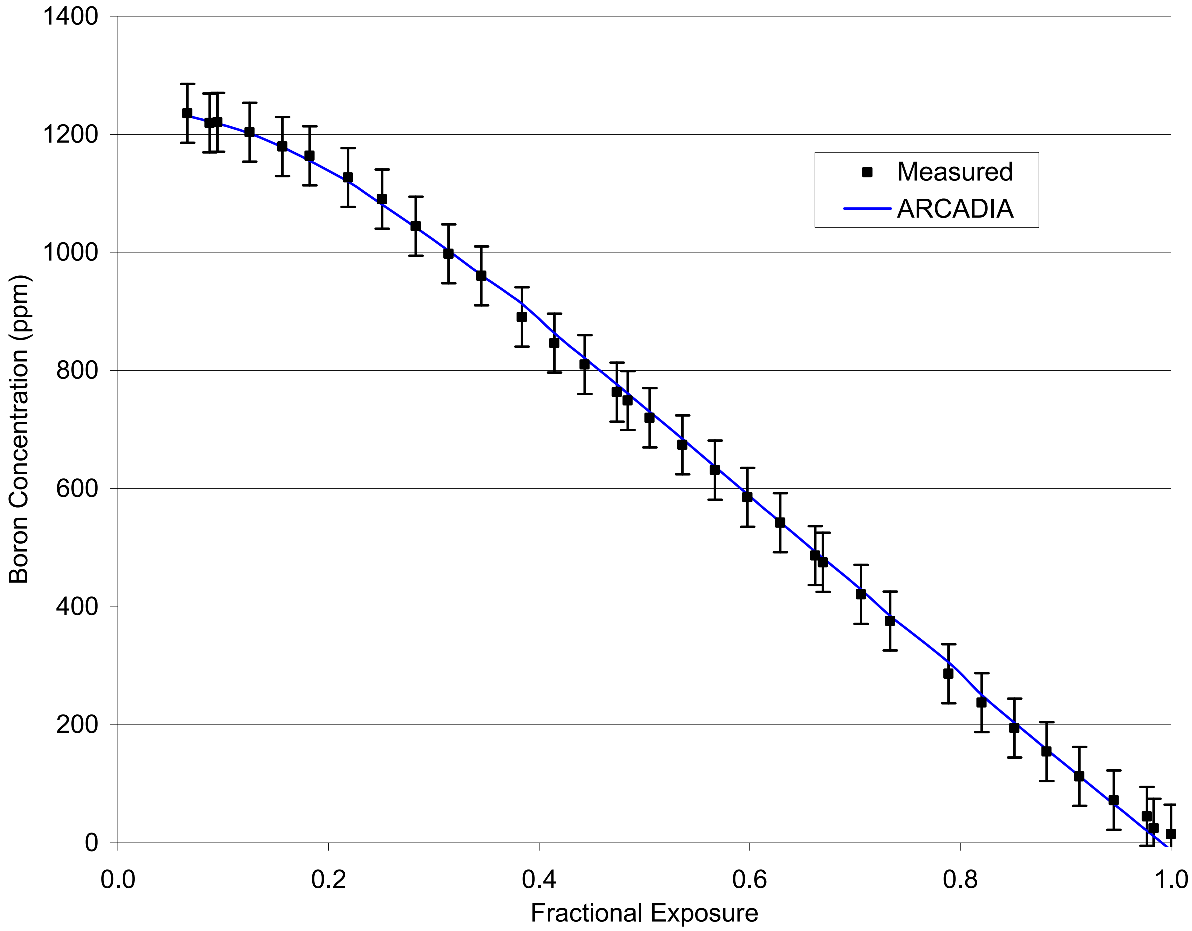


Figure A 10.4.1-4: Plant A Cycle 4 Critical Boron Concentration vs. Burnup

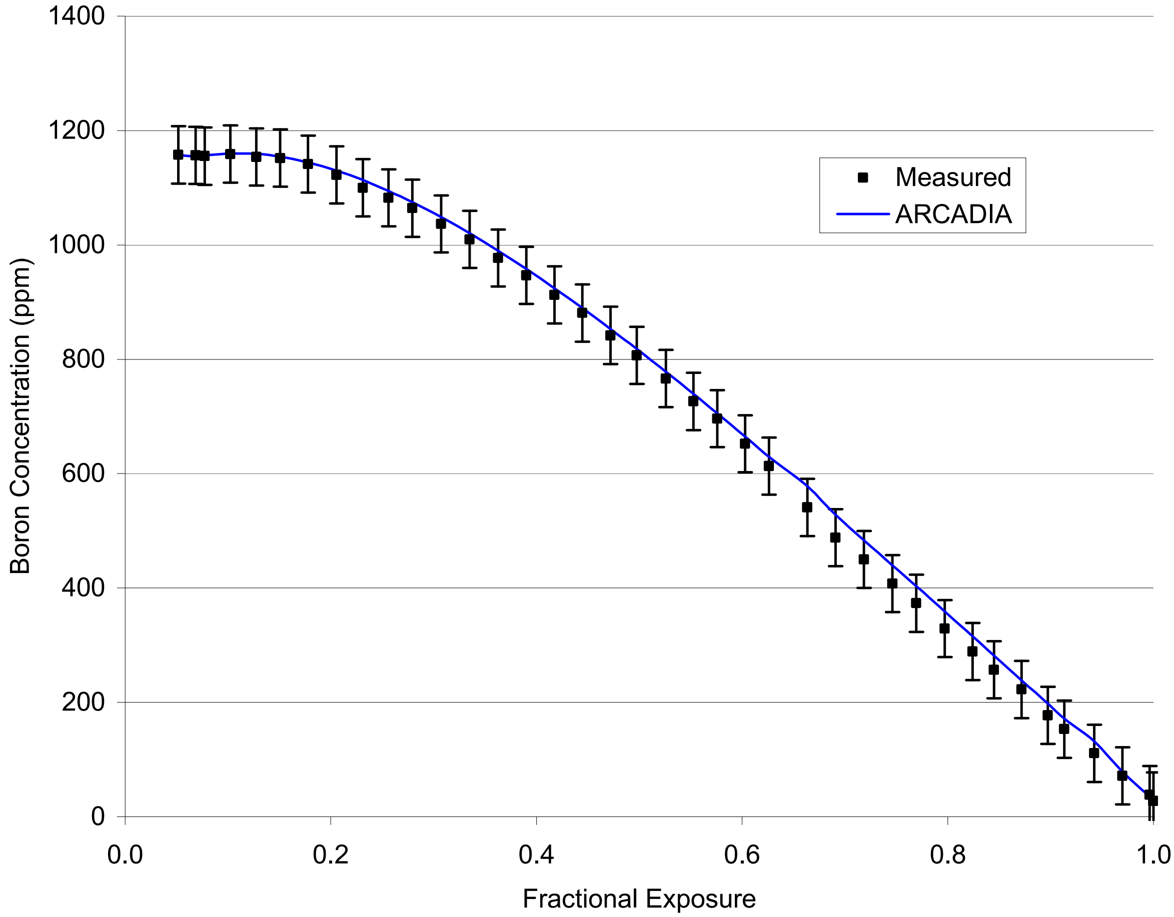


Figure A 10.4.1-5: Plant A Cycle 5 Critical Boron Concentration vs. Burnup

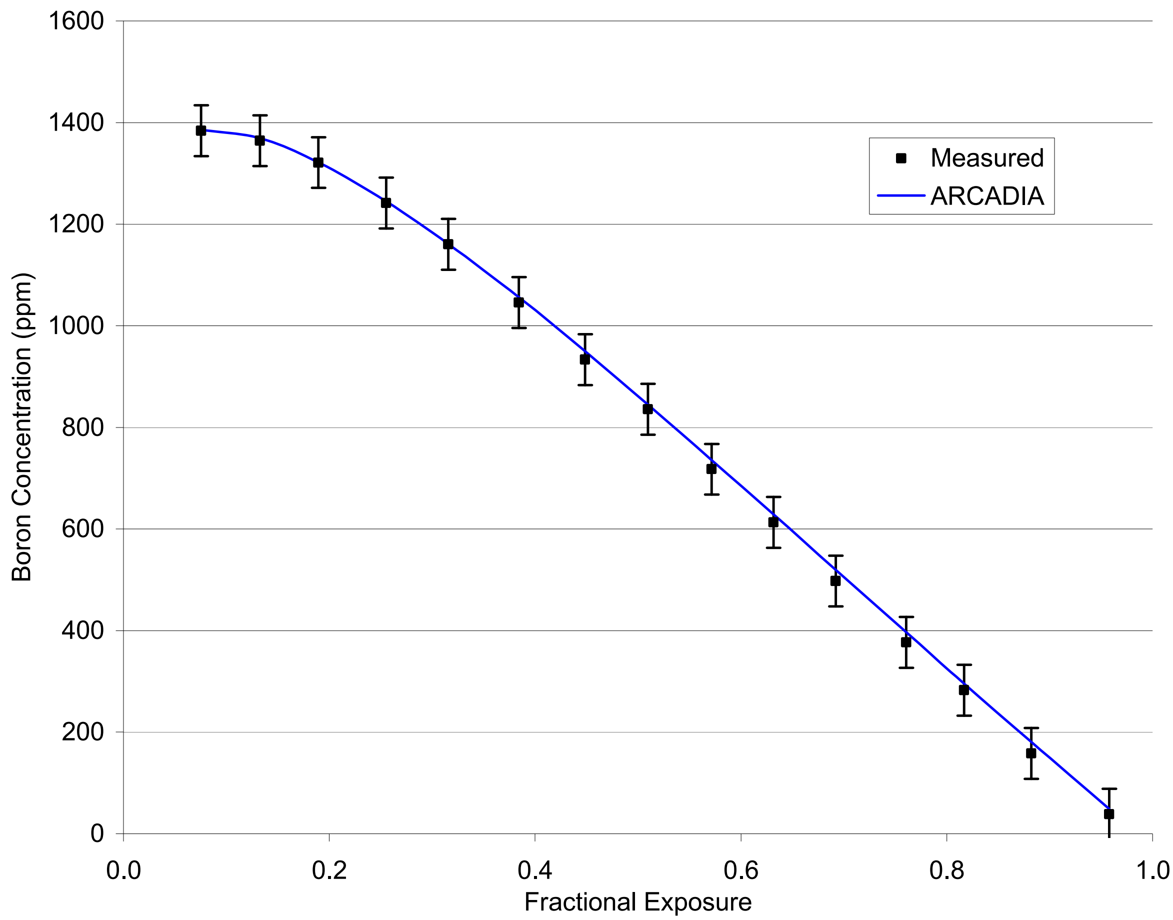


Figure A 10.4.1-6: Plant A Cycle 6 Critical Boron Concentration vs. Burnup

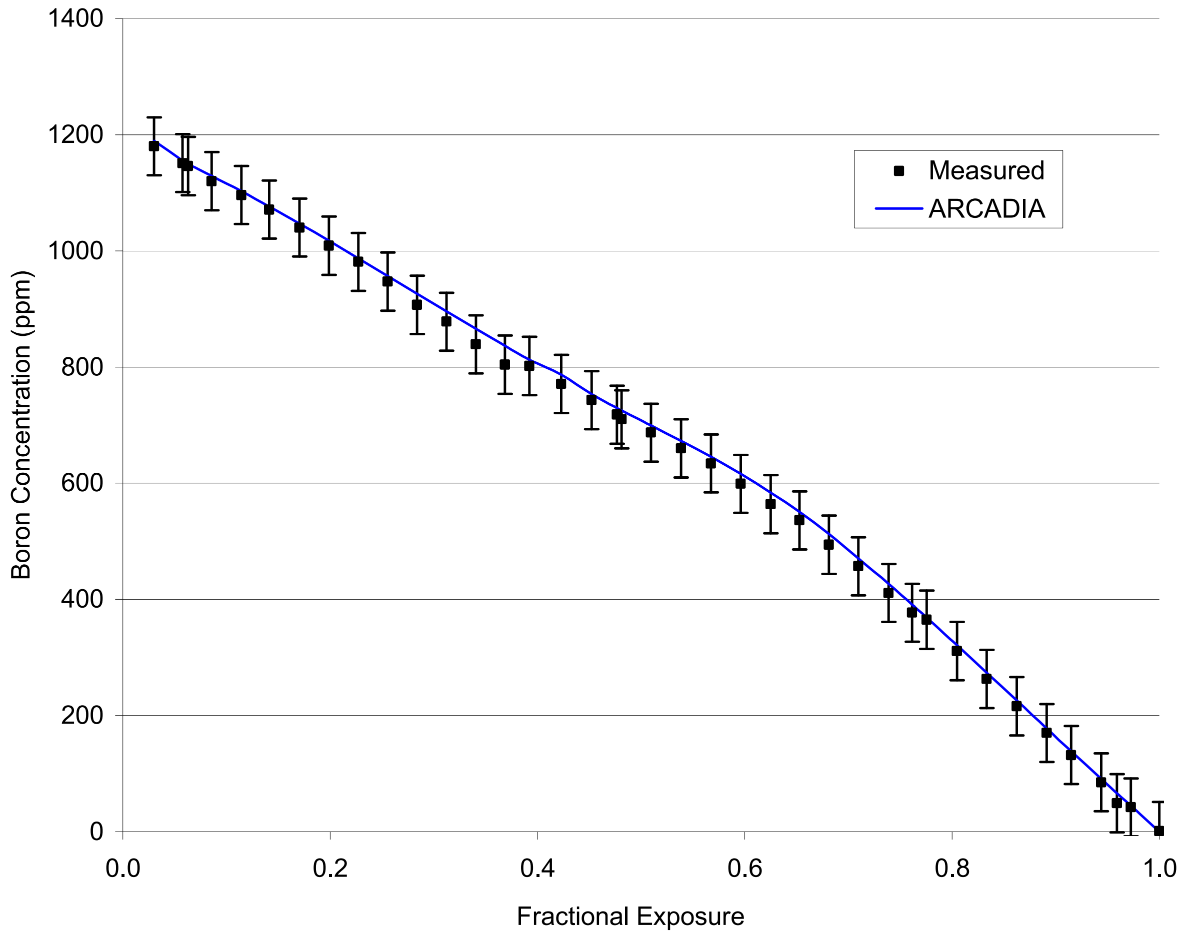


Figure A 10.4.1-7: Plant A Cycle 7 Critical Boron Concentration vs. Burnup

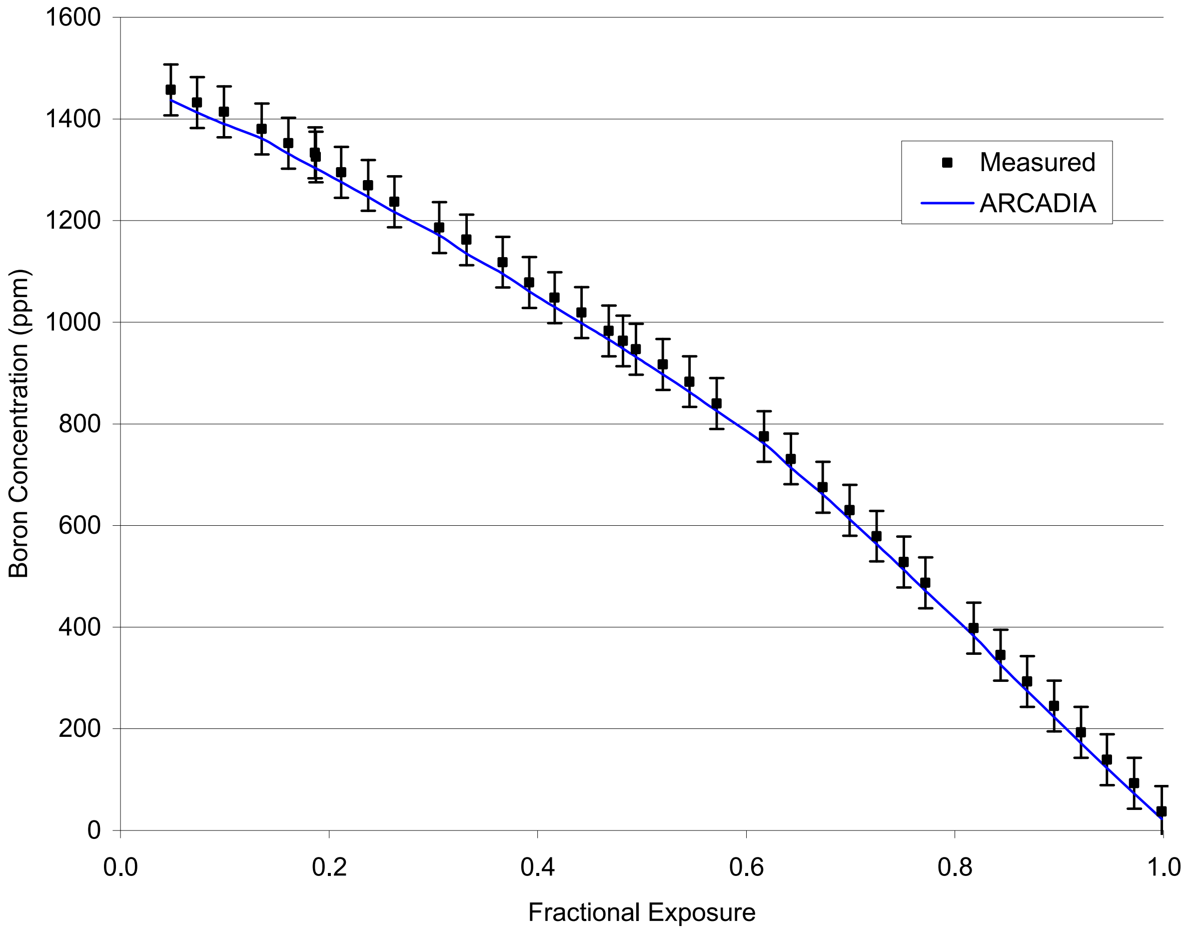


Figure A 10.4.1-8: Plant A Cycle 8 Critical Boron Concentration vs. Burnup

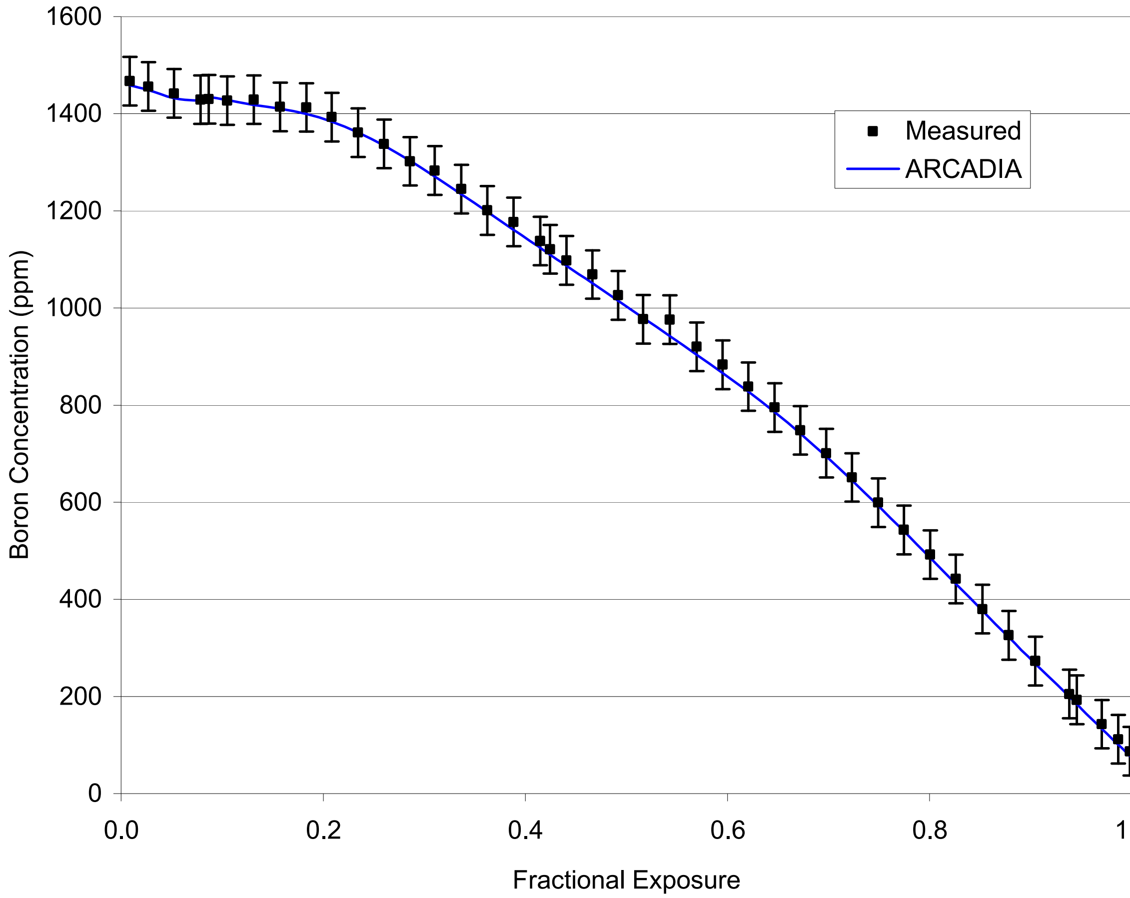


Figure A 10.4.1-9: Plant A Cycle 9 Critical Boron Concentration vs. Burnup

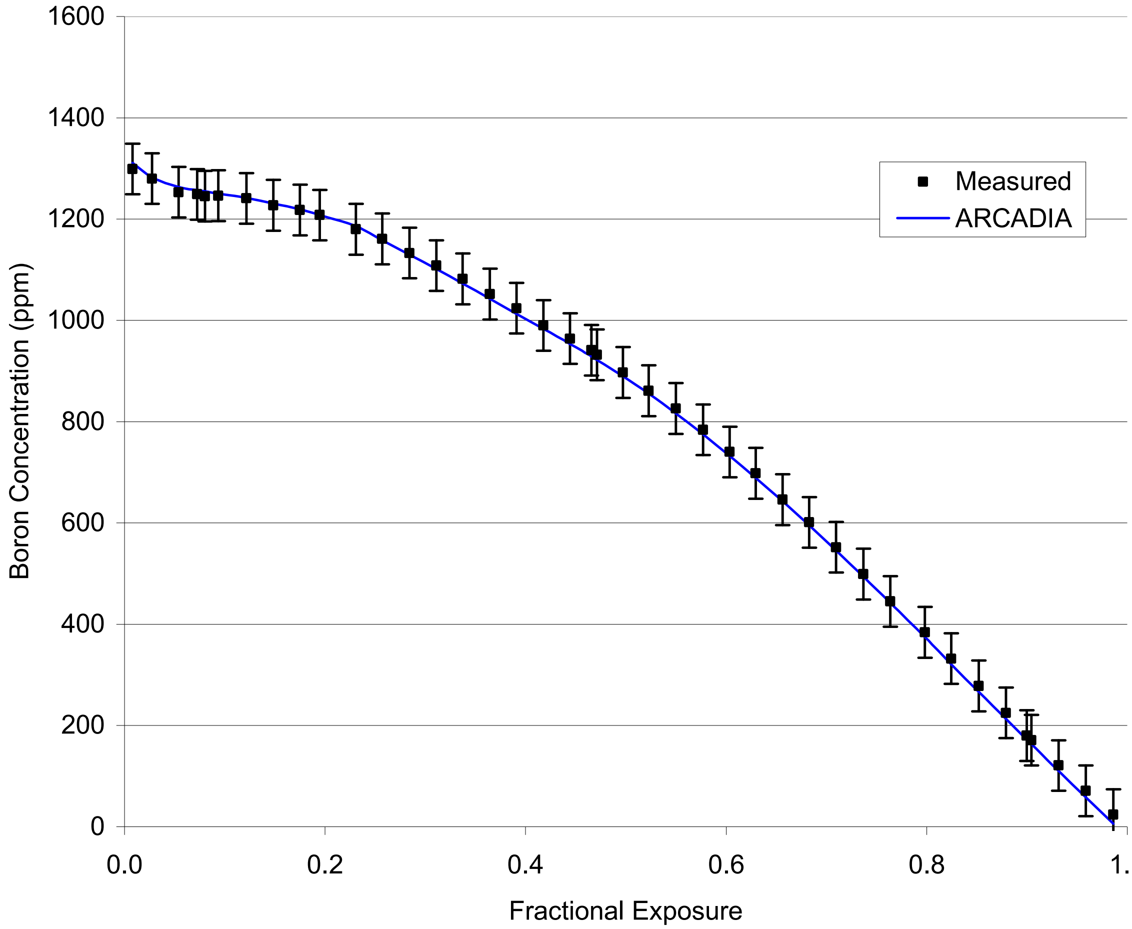


Figure A 10.4.1-10: Plant A Cycle 10 Critical Boron Concentration vs. Burnup

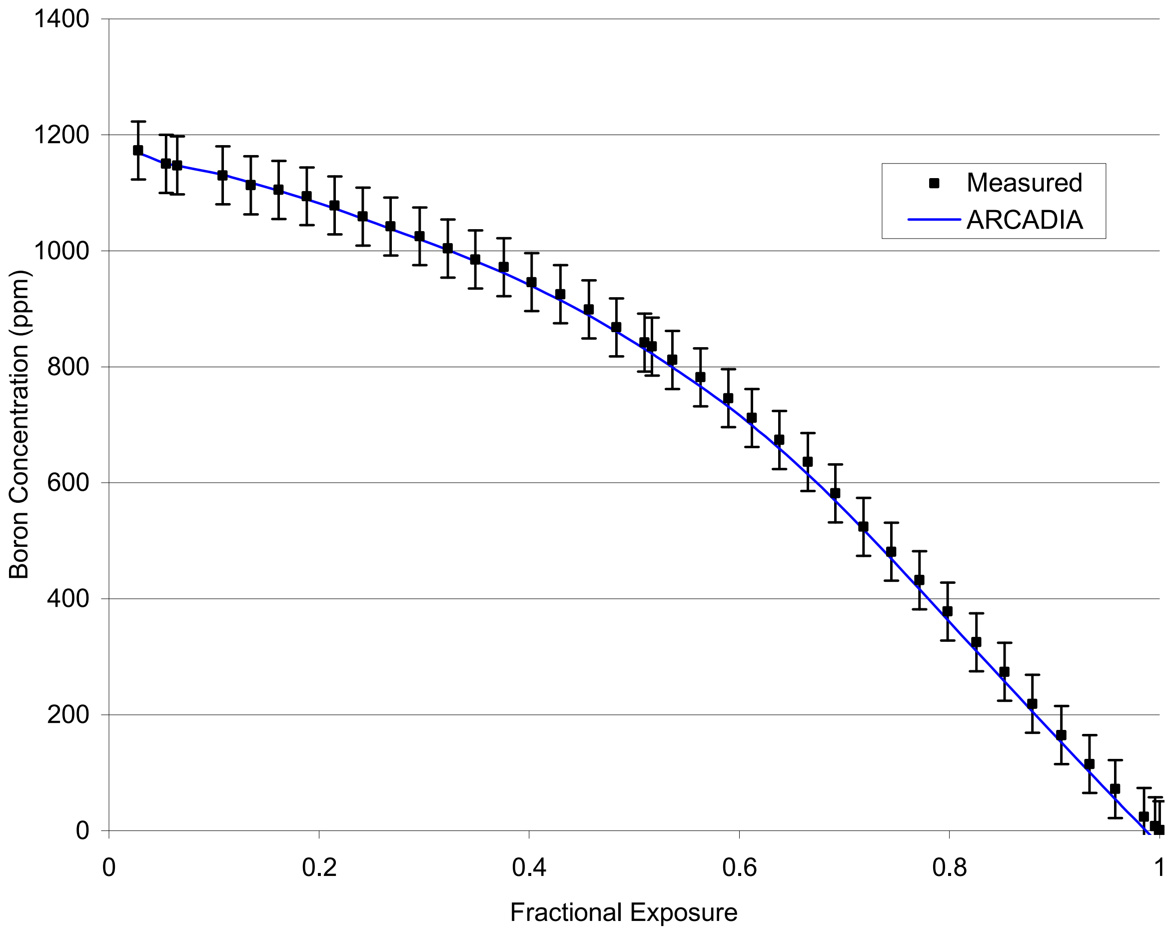


Figure A 10.4.1-11: Plant A Cycle 11 Critical Boron Concentration vs. Burnup

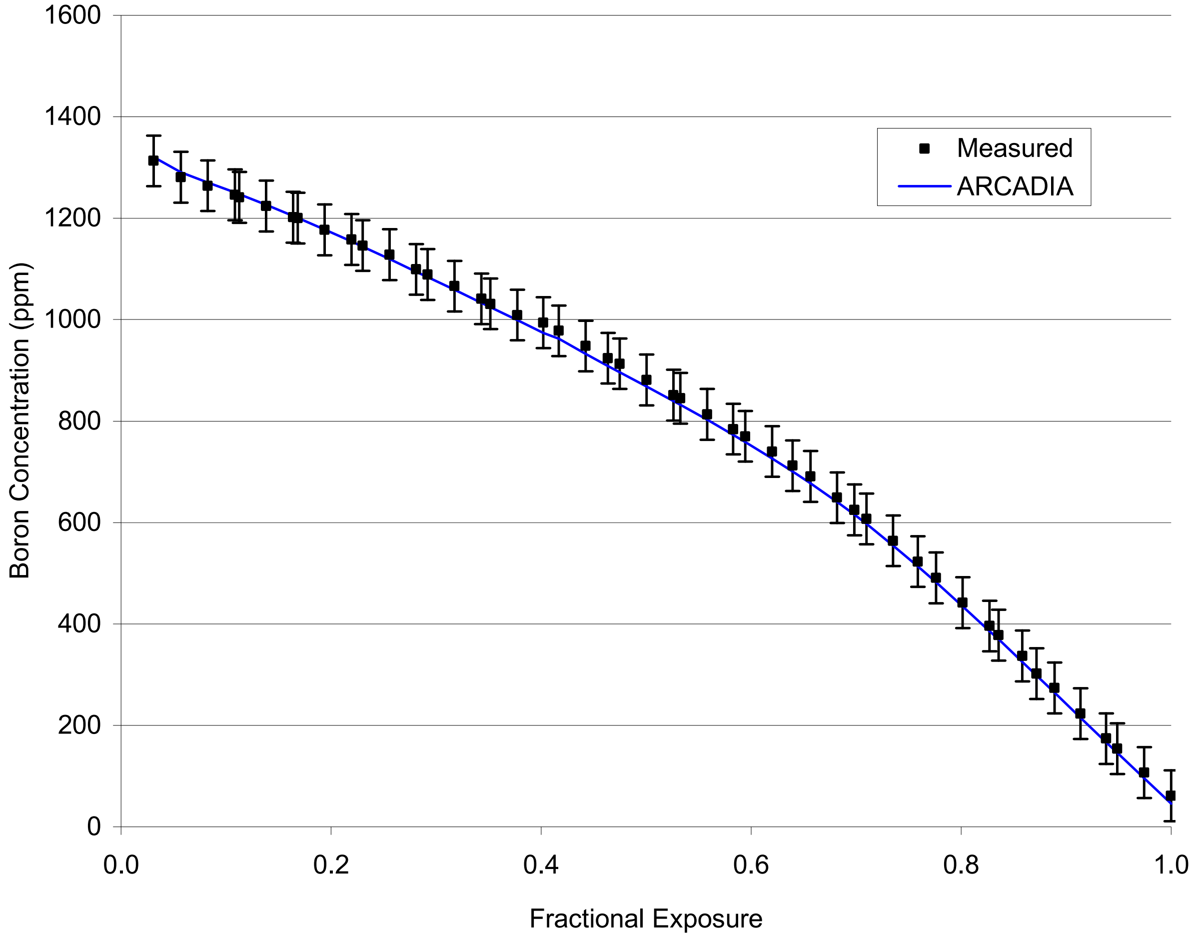


Figure A 10.4.1-12: Plant A Cycle 12 Critical Boron Concentration vs. Burnup

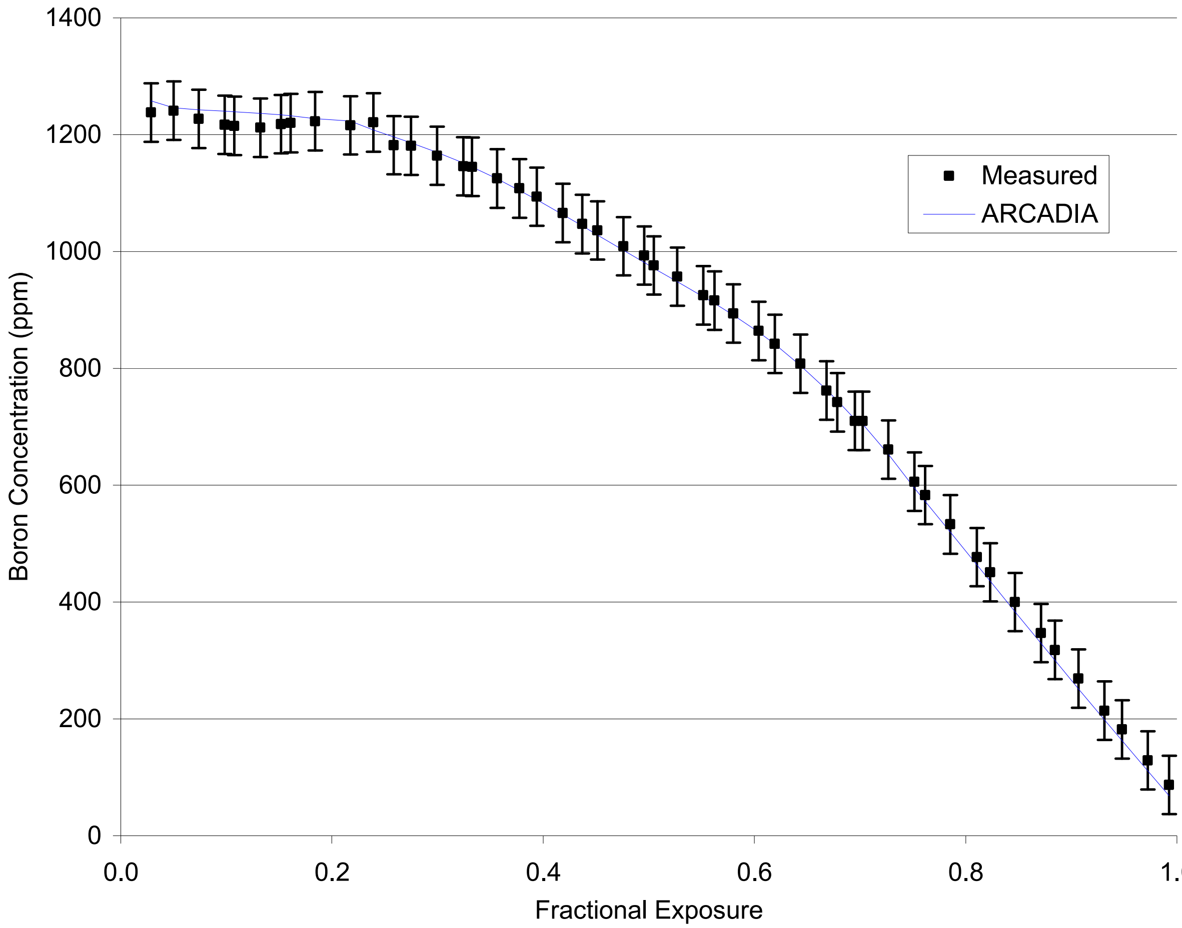


Figure A 10.4.1-13: Plant A Cycle 13 Critical Boron Concentration vs. Burnup

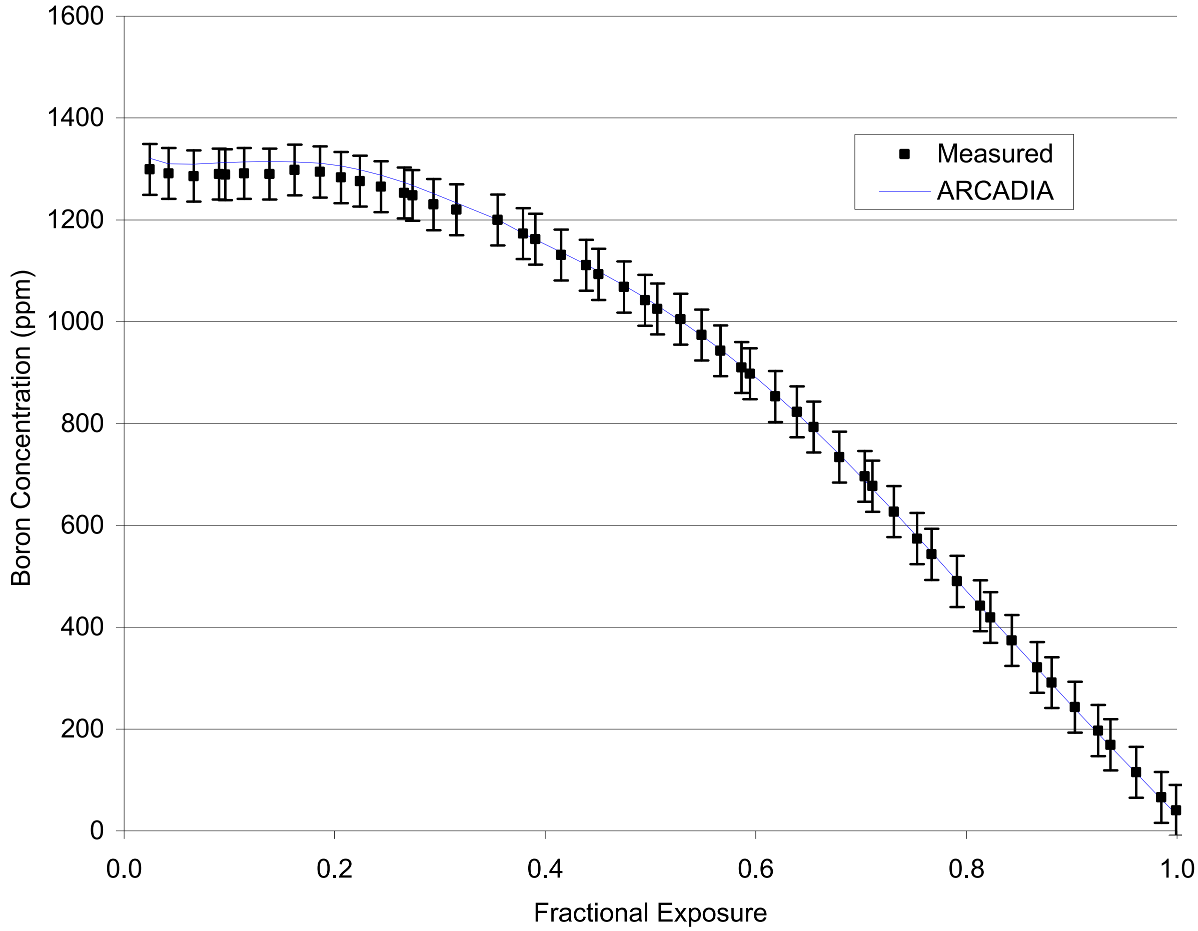


Figure A 10.4.1-14: Plant A Cycle 14 Critical Boron Concentration vs. Burnup

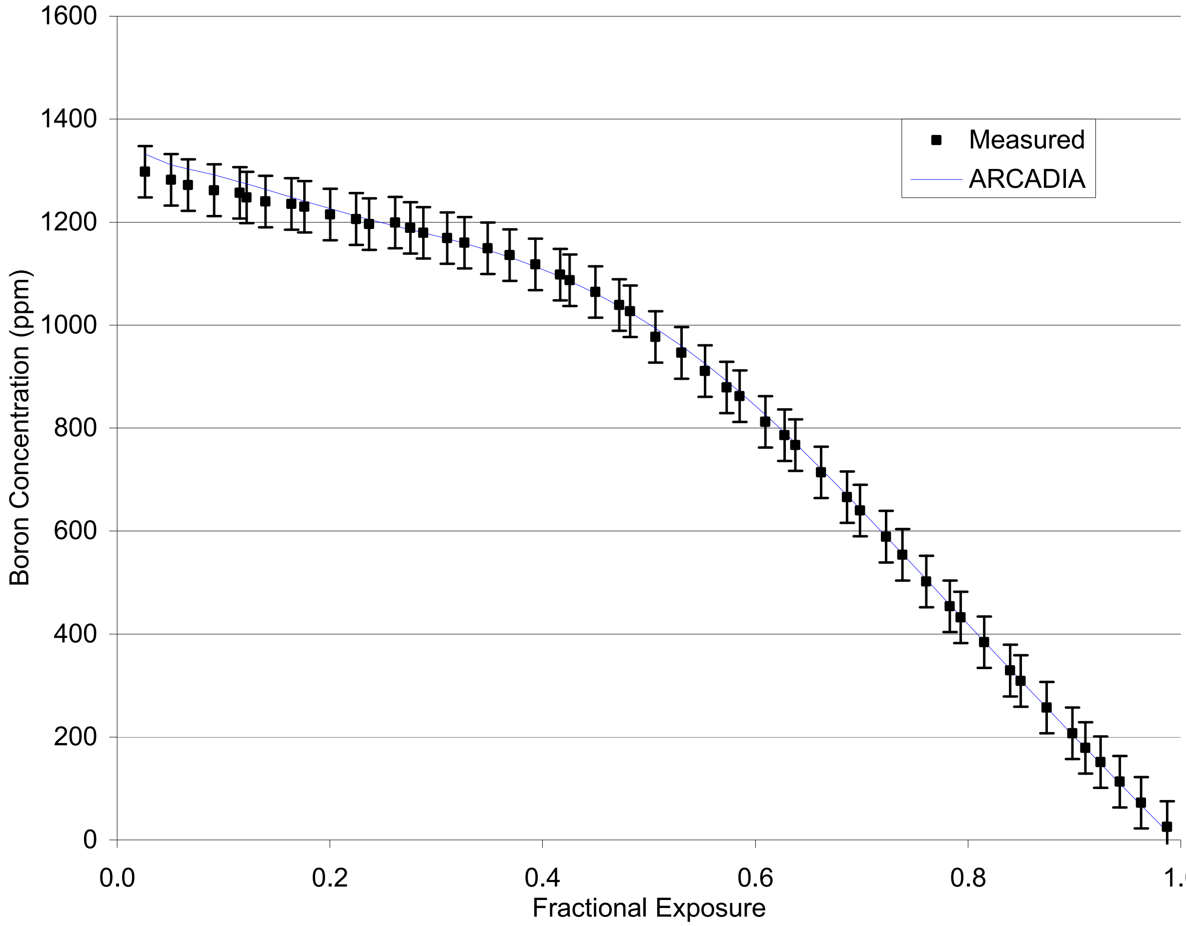


Figure A 10.4.1-15: Plant A BOC 1 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.565 0.566 -0.1	0.734 0.744 -1.0	0.565 0.568 -0.3						
2					0.650 0.648 0.2	0.882 0.876 0.6	0.933 0.925 0.8	0.945 0.936 0.9	0.933 0.932 0.2	0.882 0.896 -1.4	0.650 0.656 -0.6				
3				0.714 0.735 -2.1	1.129 1.130 -0.1	0.958 0.949 0.8	1.091 1.074 1.7	1.120 1.091 2.9	1.091 1.077 1.4	0.958 0.956 0.1	1.129 1.133 -0.4	0.714 0.722 -0.8			
4			0.714 0.708 0.6	0.918 0.916 0.2	0.974 0.964 0.9	1.120 1.106 1.4	1.120 1.101 1.9	1.171 1.130 4.1	1.120 1.097 2.3	1.120 1.110 1.0	0.974 0.973 0.0	0.918 0.936 -1.8	0.714 0.733 -1.8		
5		0.650 0.641 0.9	1.129 1.112 1.6	0.973 0.961 1.3	1.114 1.089 2.5	1.132 1.116 1.6	1.184 1.178 0.6	1.089 1.051 3.8	1.184 1.156 2.7	1.132 1.119 1.3	1.114 1.101 1.4	0.974 1.013 -3.9	1.129 1.164 -3.5	0.650 0.677 -2.7	
6		0.882 0.872 1.0	0.958 0.946 1.1	1.120 1.108 1.2	1.132 1.113 1.9	1.199 1.181 1.8	1.160 1.130 3.1	1.185 1.092 9.3	1.160 1.129 3.1	1.199 1.197 0.2	1.132 1.132 0.0	1.120 1.136 -1.6	0.958 0.974 -1.7	0.882 0.898 -1.5	
7	0.565 0.560 0.5	0.933 0.923 1.0	1.091 1.080 1.1	1.120 1.117 0.3	1.184 1.189 -0.6	1.160 1.157 0.3	1.183 1.173 1.0	1.081 1.054 2.7	1.183 1.177 0.6	1.160 1.155 0.5	1.184 1.183 0.1	1.120 1.125 -0.5	1.091 1.098 -0.6	0.933 0.934 -0.1	0.565 0.571 -0.6
8	0.734 0.728 0.6	0.945 0.933 1.1	1.120 1.096 2.3	1.171 1.177 -0.6	1.089 1.135 -4.6	1.185 1.195 -1.0	1.081 1.077 0.4	1.153 1.142 1.1	1.081 1.073 0.7	1.185 1.172 1.3	1.089 1.084 0.5	1.171 1.171 0.0	1.120 1.121 -0.1	0.945 0.953 -0.8	0.734 0.751 -1.7
9	0.565 0.564 0.1	0.933 0.936 -0.3	1.091 1.096 -0.4	1.120 1.123 -0.3	1.184 1.173 1.1	1.160 1.157 0.3	1.183 1.178 0.5	1.081 1.078 0.2	1.183 1.180 0.3	1.160 1.146 1.4	1.184 1.176 0.7	1.120 1.117 0.3	1.091 1.096 -0.4	0.933 0.948 -1.5	0.565 0.598 -3.3
10		0.882 0.901 -1.9	0.958 0.992 -3.4	1.120 1.132 -1.2	1.132 1.128 0.4	1.199 1.193 0.6	1.160 1.150 1.0	1.185 1.194 -0.9	1.160 1.165 -0.5	1.199 1.197 0.3	1.132 1.125 0.7	1.120 1.111 0.9	0.958 0.961 -0.3	0.882 0.891 -0.9	
11		0.650 0.666 -1.6	1.129 1.160 -3.1	0.973 0.984 -1.0	1.114 1.103 1.2	1.132 1.126 0.6	1.184 1.184 0.0	1.089 1.130 -4.2	1.184 1.201 -1.8	1.132 1.138 -0.6	1.114 1.106 0.9	0.974 0.971 0.2	1.129 1.140 -1.1	0.650 0.656 -0.6	
12			0.714 0.745 -3.1	0.918 0.932 -1.4	0.973 0.975 -0.1	1.120 1.112 0.8	1.120 1.095 2.5	1.171 1.181 -1.0	1.120 1.134 -1.5	1.120 1.136 -1.6	0.973 0.979 -0.5	0.918 0.914 0.4	0.714 0.739 -2.4		
13				0.714 0.723 -0.8	1.129 1.139 -1.0	0.958 0.959 -0.1	1.091 1.087 0.4	1.120 1.126 -0.6	1.091 1.107 -1.6	0.958 0.993 -3.5	1.129 1.149 -2.0	0.714 0.720 -0.5			
14					0.650 0.668 -1.8	0.882 0.890 -0.8	0.933 0.935 -0.2	0.945 0.946 -0.1	0.933 0.937 -0.4	0.882 0.900 -1.8	0.650 0.662 -1.2				
15							0.565 0.566 -0.1	0.734 0.736 -0.2	0.565 0.567 -0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.7

Figure A 10.4.1-16: Plant A MOC 1 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.537 0.538 0.0	0.680 0.687 -0.7	0.537 0.540 -0.3						
2					0.599 0.597 0.2	0.829 0.824 0.5	0.918 0.912 0.6	0.905 0.902 0.3	0.918 0.921 -0.3	0.829 0.844 -1.5	0.599 0.607 -0.8				
3				0.659 0.669 -1.0	1.039 1.038 0.1	0.984 0.978 0.7	1.062 1.049 1.3	1.116 1.097 2.0	1.062 1.057 0.5	0.984 0.989 -0.5	1.039 1.049 -1.0	0.659 0.669 -1.0			
4			0.659 0.654 0.4	0.881 0.878 0.3	1.013 1.007 0.7	1.111 1.103 0.8	1.161 1.151 1.0	1.160 1.143 1.7	1.161 1.154 0.7	1.111 1.112 -0.1	1.013 1.020 -0.7	0.881 0.900 -1.9	0.659 0.675 -1.6		
5		0.599 0.592 0.6	1.039 1.029 1.0	1.013 1.004 0.9	1.115 1.099 1.5	1.185 1.178 0.8	1.193 1.193 0.0	1.179 1.172 0.7	1.193 1.188 0.5	1.185 1.183 0.2	1.115 1.114 0.1	1.013 1.053 -3.9	1.039 1.068 -2.9	0.599 0.619 -2.0	
6		0.829 0.820 1.0	0.984 0.975 1.0	1.111 1.101 1.0	1.185 1.171 1.4	1.208 1.201 0.7	1.236 1.232 0.4	1.218 1.213 0.4	1.236 1.233 0.4	1.208 1.205 0.3	1.185 1.189 -0.3	1.111 1.126 -1.6	0.984 0.998 -1.3	0.829 0.839 -1.0	
7	0.537 0.529 0.8	0.918 0.905 1.3	1.062 1.051 1.0	1.161 1.154 0.7	1.193 1.194 -0.1	1.236 1.235 0.1	1.224 1.219 0.5	1.206 1.202 0.3	1.224 1.222 0.2	1.236 1.235 0.1	1.193 1.194 -0.1	1.161 1.165 -0.4	1.062 1.064 -0.2	0.918 0.914 0.4	0.537 0.538 -0.1
8	0.680 0.669 1.1	0.905 0.887 1.8	1.116 1.074 4.2	1.160 1.154 0.6	1.179 1.206 -2.7	1.218 1.224 -0.6	1.206 1.205 0.1	1.218 1.217 0.1	1.206 1.204 0.1	1.218 1.217 0.0	1.179 1.177 0.1	1.160 1.159 0.2	1.116 1.110 0.7	0.905 0.899 0.6	0.680 0.687 -0.7
9	0.537 0.531 0.6	0.918 0.911 0.7	1.062 1.054 0.8	1.161 1.157 0.3	1.193 1.189 0.4	1.236 1.235 0.2	1.224 1.221 0.3	1.206 1.206 0.0	1.224 1.222 0.2	1.236 1.227 0.9	1.193 1.189 0.4	1.161 1.158 0.3	1.062 1.061 0.1	0.918 0.925 -0.7	0.537 0.565 -2.8
10		0.829 0.836 -0.7	0.984 1.005 -2.0	1.111 1.116 -0.5	1.185 1.181 0.4	1.208 1.202 0.5	1.236 1.227 1.0	1.218 1.226 -0.8	1.236 1.241 -0.5	1.208 1.207 0.0	1.185 1.182 0.3	1.111 1.106 0.5	0.984 0.985 -0.1	0.829 0.833 -0.3	
11		0.599 0.607 -0.8	1.039 1.057 -1.8	1.013 1.018 -0.5	1.115 1.104 1.0	1.185 1.178 0.7	1.193 1.192 0.1	1.179 1.215 -3.6	1.193 1.207 -1.4	1.185 1.191 -0.5	1.115 1.112 0.3	1.013 1.012 0.1	1.039 1.044 -0.5	0.599 0.602 -0.3	
12			0.659 0.682 -2.3	0.881 0.888 -0.7	1.013 1.010 0.3	1.111 1.101 1.0	1.161 1.136 2.5	1.160 1.165 -0.4	1.161 1.169 -0.8	1.111 1.121 -1.0	1.013 1.017 -0.3	0.881 0.877 0.4	0.659 0.673 -1.4		
13				0.659 0.662 -0.3	1.039 1.040 -0.1	0.984 0.979 0.5	1.062 1.052 1.0	1.116 1.114 0.2	1.062 1.066 -0.4	0.984 1.006 -2.2	1.039 1.050 -1.1	0.659 0.661 -0.2			
14					0.599 0.607 -0.8	0.829 0.828 0.1	0.918 0.912 0.6	0.905 0.898 0.7	0.918 0.904 1.3	0.829 0.834 -0.4	0.599 0.604 -0.5				
15							0.537 0.533 0.4	0.680 0.674 0.6	0.537 0.531 0.7						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.1

Figure A 10.4.1-17: Plant A EOC 1 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.615 0.604 1.0	0.753 0.730 2.3	0.615 0.604 1.1						
2					0.641 0.638 0.2	0.879 0.876 0.4	1.015 1.008 0.7	0.986 0.971 1.5	1.015 1.005 1.0	0.879 0.879 0.0	0.641 0.642 -0.1	Calculated Power Measured Power Difference (C-M)*100			
3				0.693 0.691 0.3	1.042 1.038 0.4	1.062 1.060 0.1	1.067 1.071 -0.4	1.135 1.115 2.0	1.067 1.060 0.7	1.062 1.062 0.0	1.042 1.045 -0.4	0.693 0.698 -0.5			
4			0.693 0.686 0.7	0.907 0.900 0.7	1.077 1.071 0.6	1.086 1.085 0.1	1.146 1.150 -0.3	1.100 1.099 0.1	1.146 1.147 0.0	1.086 1.089 -0.3	1.077 1.083 -0.6	0.907 0.917 -0.9	0.693 0.702 -0.8		
5		0.641 0.633 0.8	1.042 1.028 1.3	1.077 1.065 1.2	1.083 1.072 1.1	1.147 1.146 0.1	1.101 1.113 -1.2	1.142 1.149 -0.7	1.101 1.106 -0.6	1.147 1.154 -0.7	1.083 1.090 -0.8	1.077 1.094 -1.7	1.042 1.056 -1.4	0.641 0.660 -1.9	
6		0.879 0.869 1.1	1.062 1.048 1.4	1.086 1.071 1.5	1.147 1.122 2.5	1.099 1.094 0.4	1.148 1.154 -0.6	1.098 1.109 -1.0	1.148 1.157 -0.9	1.099 1.110 -1.1	1.147 1.155 -0.8	1.086 1.093 -0.7	1.062 1.064 -0.2	0.879 0.878 0.2	
7	0.615 0.609 0.6	1.015 1.004 1.1	1.067 1.052 1.5	1.146 1.138 0.9	1.101 1.097 0.4	1.148 1.149 -0.1	1.097 1.102 -0.5	1.138 1.149 -1.1	1.097 1.104 -0.7	1.148 1.156 -0.8	1.101 1.105 -0.4	1.146 1.146 0.0	1.067 1.058 0.9	1.015 0.987 2.8	0.615 0.605 1.0
8	0.753 0.747 0.6	0.986 0.979 0.7	1.135 1.129 0.7	1.100 1.101 -0.1	1.142 1.158 -1.6	1.098 1.107 -0.9	1.138 1.149 -1.1	1.097 1.116 -1.9	1.138 1.164 -2.6	1.098 1.108 -0.9	1.142 1.145 -0.2	1.100 1.097 0.3	1.135 1.123 1.2	0.986 0.985 0.1	0.753 0.753 0.0
9	0.615 0.611 0.4	1.015 1.011 0.4	1.067 1.064 0.3	1.146 1.149 -0.2	1.101 1.110 -0.9	1.148 1.156 -0.8	1.097 1.108 -1.1	1.138 1.168 -2.9	1.097 1.164 -6.7	1.148 1.140 0.8	1.101 1.099 0.2	1.146 1.144 0.3	1.067 1.063 0.4	1.015 1.016 -0.1	0.615 0.625 -1.0
10		0.879 0.878 0.1	1.062 1.058 0.4	1.086 1.089 -0.3	1.147 1.151 -0.4	1.099 1.101 -0.2	1.148 1.146 0.2	1.098 1.116 -1.7	1.148 1.175 -2.7	1.099 1.105 -0.7	1.147 1.149 -0.2	1.086 1.085 0.1	1.062 1.060 0.2	0.879 0.879 0.1	
11		0.641 0.645 -0.4	1.042 1.055 -1.4	1.077 1.085 -0.8	1.083 1.086 -0.3	1.147 1.145 0.2	1.101 1.098 0.3	1.142 1.160 -1.8	1.101 1.114 -1.3	1.147 1.154 -0.7	1.083 1.086 -0.3	1.077 1.067 0.9	1.042 1.039 0.2	0.641 0.640 0.1	
12			0.693 0.730 -3.7	0.907 0.920 -1.2	1.077 1.077 -0.1	1.086 1.077 0.9	1.146 1.121 2.5	1.100 1.097 0.3	1.146 1.149 -0.3	1.086 1.089 -0.3	1.077 1.068 0.9	0.907 0.872 3.5	0.693 0.698 -0.4		
13				0.693 0.696 -0.3	1.042 1.038 0.4	1.062 1.053 0.9	1.067 1.054 1.3	1.135 1.127 0.8	1.067 1.065 0.2	1.062 1.072 -1.0	1.042 1.037 0.4	0.693 0.679 1.4			
14					0.641 0.633 0.7	0.879 0.870 0.9	1.015 1.003 1.2	0.986 0.975 1.1	1.015 1.000 1.5	0.879 0.877 0.2	0.641 0.638 0.2				
15							0.615 0.608 0.7	0.753 0.744 0.9	0.615 0.606 0.8						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.2

Figure A 10.4.1-18: Plant A BOC 2 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.346 0.344 0.2	0.409 0.407 0.2	0.343 0.343 0.0						
2					0.429 0.429 0.0	0.958 0.954 0.4	1.156 1.148 0.7	0.991 0.984 0.7	1.144 1.143 0.0	0.954 0.965 -1.1	0.428 0.432 -0.4				
3				0.410 0.418 -0.8	1.126 1.126 0.0	1.284 1.280 0.4	1.104 1.098 0.5	1.147 1.131 1.6	1.099 1.097 0.2	1.280 1.283 -0.2	1.124 1.128 -0.4	0.410 0.415 -0.6			
4			0.410 0.410 0.0	0.745 0.746 -0.1	1.273 1.270 0.3	1.071 1.070 0.1	1.173 1.173 -0.1	1.261 1.266 -0.6	1.173 1.174 -0.1	1.070 1.067 0.3	1.271 1.272 -0.2	0.745 0.748 -0.3	0.410 0.412 -0.2		
5		0.428 0.427 0.2	1.124 1.121 0.3	1.270 1.266 0.4	1.231 1.230 0.0	1.129 1.129 0.0	1.015 1.017 -0.2	0.991 0.994 -0.3	1.023 1.024 -0.1	1.133 1.134 0.0	1.231 1.236 -0.5	1.273 1.276 -0.3	1.126 1.131 -0.5	0.429 0.439 -0.9	
6		0.954 0.947 0.7	1.280 1.271 0.9	1.070 1.065 0.5	1.133 1.125 0.8	1.157 1.155 0.2	1.250 1.251 -0.1	1.207 1.211 -0.4	1.269 1.268 0.1	1.158 1.154 0.3	1.129 1.131 -0.2	1.071 1.074 -0.3	1.284 1.287 -0.3	0.958 0.960 -0.2	
7	0.343 0.341 0.2	1.144 1.134 0.9	1.099 1.089 1.1	1.173 1.166 0.7	1.023 1.016 0.6	1.269 1.266 0.3	1.202 1.208 -0.6	1.216 1.220 -0.4	1.204 1.205 -0.1	1.252 1.249 0.3	1.015 1.017 -0.1	1.173 1.177 -0.4	1.104 1.106 -0.2	1.156 1.150 0.6	0.346 0.345 0.1
8	0.409 0.408 0.1	0.991 0.987 0.3	1.147 1.147 0.0	1.261 1.253 0.8	0.991 0.977 1.3	1.207 1.205 0.2	1.216 1.220 -0.4	0.958 0.963 -0.5	1.221 1.226 -0.5	1.208 1.205 0.3	0.991 0.992 -0.1	1.261 1.263 -0.1	1.147 1.151 -0.5	0.991 0.984 0.7	0.409 0.409 0.0
9	0.346 0.345 0.1	1.156 1.151 0.5	1.104 1.102 0.2	1.173 1.171 0.1	1.015 1.018 -0.3	1.251 1.253 -0.2	1.204 1.211 -0.7	1.221 1.230 -1.0	1.206 1.225 -1.8	1.271 1.262 0.9	1.023 1.023 0.0	1.174 1.176 -0.3	1.100 1.105 -0.5	1.144 1.148 -0.4	0.343 0.350 -0.7
10		0.958 0.954 0.4	1.284 1.277 0.7	1.071 1.071 0.0	1.129 1.132 -0.3	1.158 1.163 -0.5	1.270 1.282 -1.2	1.208 1.214 -0.5	1.252 1.256 -0.4	1.158 1.157 0.2	1.134 1.136 -0.2	1.070 1.072 -0.2	1.281 1.288 -0.7	0.954 0.964 -1.0	
11		0.429 0.430 0.0	1.126 1.128 -0.2	1.273 1.275 -0.1	1.231 1.233 -0.2	1.134 1.137 -0.4	1.023 1.027 -0.4	0.991 0.985 0.6	1.016 1.013 0.2	1.129 1.124 0.5	1.231 1.239 -0.7	1.271 1.279 -0.8	1.124 1.135 -1.1	0.428 0.433 -0.5	
12			0.410 0.423 -1.4	0.745 0.750 -0.5	1.271 1.271 0.0	1.070 1.072 -0.2	1.174 1.177 -0.4	1.261 1.252 0.9	1.173 1.167 0.6	1.071 1.069 0.2	1.273 1.277 -0.4	0.745 0.757 -1.2	0.410 0.424 -1.4		
13				0.410 0.411 -0.1	1.124 1.122 0.3	1.281 1.276 0.5	1.100 1.094 0.5	1.147 1.128 1.9	1.104 1.094 0.9	1.284 1.279 0.5	1.126 1.126 0.0	0.410 0.413 -0.3			
14					0.428 0.427 0.1	0.954 0.949 0.5	1.144 1.136 0.8	0.991 0.980 1.1	1.156 1.142 1.3	0.958 0.952 0.7	0.429 0.428 0.1				
15							0.343 0.345 -0.2	0.409 0.406 0.3	0.346 0.343 0.3						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-19: Plant A MOC 2 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.363 0.360 0.3	0.428 0.417 1.0	0.361 0.359 0.1						
2					0.446 0.447 -0.1	0.945 0.943 0.1	1.126 1.122 0.4	0.969 0.965 0.4	1.119 1.121 -0.2	0.943 0.955 -1.3	0.445 0.449 -0.4				
3				0.432 0.441 -0.9	1.101 1.105 -0.4	1.301 1.301 0.0	1.086 1.085 0.1	1.123 1.118 0.6	1.083 1.086 -0.2	1.299 1.307 -0.8	1.101 1.107 -0.7	0.432 0.435 -0.2			
4			0.432 0.432 0.0	0.760 0.764 -0.4	1.263 1.268 -0.4	1.057 1.060 -0.3	1.158 1.159 -0.1	1.289 1.289 0.0	1.159 1.162 -0.3	1.057 1.062 -0.5	1.262 1.268 -0.7	0.760 0.763 -0.3	0.432 0.434 -0.2		
5		0.445 0.443 0.2	1.101 1.096 0.5	1.262 1.262 0.0	1.191 1.199 -0.8	1.110 1.113 -0.3	1.026 1.028 -0.2	1.010 1.011 -0.2	1.032 1.035 -0.3	1.113 1.118 -0.5	1.191 1.200 -0.8	1.263 1.267 -0.3	1.101 1.104 -0.3	0.445 0.450 -0.4	
6		0.943 0.937 0.5	1.299 1.292 0.8	1.057 1.053 0.4	1.113 1.105 0.9	1.155 1.153 0.1	1.317 1.318 -0.1	1.210 1.211 -0.1	1.332 1.334 -0.2	1.155 1.158 -0.3	1.110 1.114 -0.4	1.057 1.060 -0.3	1.301 1.303 -0.2	0.945 0.945 0.0	
7	0.361 0.359 0.1	1.119 1.113 0.6	1.083 1.076 0.8	1.159 1.154 0.5	1.032 1.027 0.6	1.331 1.329 0.2	1.200 1.207 -0.6	1.200 1.204 -0.4	1.202 1.206 -0.5	1.317 1.317 0.0	1.026 1.028 -0.2	1.158 1.161 -0.2	1.086 1.088 -0.2	1.126 1.122 0.5	0.363 0.362 0.1
8	0.428 0.427 0.0	0.969 0.969 0.0	1.123 1.129 -0.6	1.289 1.284 0.5	1.010 0.999 1.1	1.210 1.208 0.2	1.200 1.203 -0.3	0.965 0.969 -0.5	1.203 1.209 -0.6	1.211 1.206 0.5	1.010 1.010 0.1	1.289 1.291 -0.2	1.123 1.130 -0.7	0.969 0.961 0.8	0.428 0.428 0.0
9	0.363 0.363 0.0	1.126 1.125 0.2	1.086 1.086 0.0	1.158 1.157 0.2	1.026 1.024 0.2	1.317 1.316 0.1	1.202 1.204 -0.3	1.203 1.211 -0.8	1.203 1.222 -1.9	1.332 1.323 1.0	1.032 1.030 0.2	1.159 1.159 0.0	1.083 1.085 -0.2	1.119 1.118 0.0	0.361 0.368 -0.7
10		0.945 0.942 0.3	1.301 1.295 0.6	1.057 1.057 0.1	1.110 1.110 0.0	1.155 1.155 0.0	1.332 1.334 -0.2	1.211 1.214 -0.3	1.318 1.324 -0.6	1.155 1.155 0.0	1.113 1.114 -0.1	1.057 1.054 0.3	1.299 1.300 0.0	0.942 0.943 0.0	
11		0.446 0.445 0.0	1.101 1.102 -0.1	1.263 1.265 -0.1	1.191 1.195 -0.4	1.113 1.113 0.0	1.032 1.030 0.2	1.010 1.008 0.2	1.026 1.027 -0.1	1.110 1.112 -0.2	1.191 1.200 -0.9	1.262 1.264 -0.3	1.101 1.104 -0.4	0.445 0.446 -0.1	
12			0.432 0.441 -0.9	0.760 0.763 -0.3	1.262 1.261 0.1	1.057 1.054 0.3	1.159 1.150 0.9	1.289 1.282 0.7	1.158 1.155 0.4	1.057 1.056 0.1	1.263 1.265 -0.2	0.760 0.763 -0.3	0.432 0.441 -0.9		
13				0.432 0.432 0.0	1.101 1.097 0.4	1.299 1.292 0.7	1.083 1.076 0.7	1.123 1.116 0.7	1.086 1.080 0.6	1.301 1.295 0.6	1.101 1.099 0.2	0.432 0.432 -0.1			
14					0.445 0.443 0.2	0.942 0.936 0.7	1.119 1.108 1.1	0.969 0.961 0.8	1.126 1.115 1.2	0.945 0.938 0.6	0.445 0.444 0.2				
15							0.361 0.354 0.6	0.428 0.423 0.4	0.363 0.359 0.3						

Calculated Power
Measured Power
Difference (C-M)*100

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure A 10.4.1-20: Plant A EOC 2 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.397 0.396 0.1	0.467 0.465 0.2	0.396 0.396 0.0						
2					0.475 0.474 0.1	0.948 0.945 0.3	1.122 1.117 0.4	0.977 0.973 0.3	1.117 1.120 -0.3	0.947 0.958 -1.1	0.475 0.479 -0.4				
3				0.468 0.473 -0.5	1.089 1.088 0.1	1.305 1.301 0.4	1.079 1.075 0.4	1.113 1.104 0.9	1.078 1.078 -0.1	1.304 1.310 -0.6	1.090 1.094 -0.4	0.469 0.470 -0.1			
4			0.469 0.467 0.2	0.787 0.786 0.1	1.249 1.246 0.3	1.050 1.048 0.2	1.144 1.142 0.3	1.289 1.282 0.6	1.145 1.146 -0.1	1.050 1.054 -0.4	1.248 1.251 -0.3	0.787 0.785 0.2	0.468 0.467 0.1		
5		0.475 0.473 0.2	1.090 1.083 0.7	1.248 1.243 0.5	1.162 1.158 0.4	1.093 1.092 0.1	1.027 1.028 -0.1	1.015 1.017 -0.2	1.032 1.037 -0.5	1.095 1.102 -0.7	1.162 1.165 -0.3	1.249 1.239 0.9	1.089 1.086 0.4	0.475 0.477 -0.2	
6		0.947 0.945 0.2	1.304 1.301 0.3	1.050 1.048 0.2	1.095 1.089 0.6	1.137 1.138 -0.1	1.322 1.328 -0.6	1.186 1.194 -0.9	1.331 1.344 -1.3	1.137 1.153 -1.6	1.093 1.099 -0.7	1.050 1.050 0.0	1.305 1.302 0.2	0.948 0.944 0.3	
7	0.396 0.396 0.0	1.117 1.117 0.0	1.078 1.079 -0.2	1.145 1.146 -0.1	1.032 1.032 0.0	1.331 1.336 -0.5	1.171 1.182 -1.1	1.163 1.174 -1.1	1.171 1.187 -1.5	1.322 1.335 -1.3	1.027 1.034 -0.7	1.144 1.147 -0.3	1.079 1.079 0.0	1.122 1.113 0.9	0.397 0.396 0.2
8	0.467 0.467 0.0	0.977 0.979 -0.2	1.113 1.122 -1.0	1.289 1.291 -0.2	1.015 1.016 -0.1	1.186 1.189 -0.4	1.163 1.170 -0.7	0.957 0.966 -0.9	1.165 1.179 -1.4	1.186 1.196 -1.1	1.015 1.021 -0.6	1.289 1.294 -0.6	1.113 1.120 -0.7	0.977 0.976 0.1	0.467 0.468 -0.1
9	0.397 0.397 0.1	1.122 1.117 0.4	1.079 1.076 0.3	1.144 1.143 0.1	1.027 1.028 -0.1	1.322 1.323 -0.1	1.171 1.174 -0.3	1.165 1.174 -0.9	1.172 1.191 -1.9	1.331 1.329 0.2	1.032 1.034 -0.2	1.145 1.148 -0.3	1.077 1.081 -0.4	1.117 1.119 -0.3	0.396 0.402 -0.6
10		0.948 0.938 0.9	1.305 1.285 2.0	1.050 1.044 0.6	1.093 1.092 0.1	1.137 1.136 0.1	1.331 1.326 0.5	1.186 1.191 -0.5	1.322 1.330 -0.8	1.137 1.139 -0.2	1.095 1.098 -0.3	1.050 1.051 -0.1	1.304 1.307 -0.3	0.947 0.949 -0.2	
11		0.475 0.471 0.4	1.089 1.081 0.9	1.249 1.244 0.5	1.162 1.163 -0.1	1.095 1.095 0.0	1.032 1.032 0.0	1.015 1.022 -0.7	1.027 1.030 -0.3	1.093 1.094 -0.1	1.162 1.167 -0.5	1.248 1.249 -0.1	1.089 1.092 -0.2	0.475 0.476 -0.1	
12			0.468 0.470 -0.1	0.787 0.785 0.1	1.248 1.245 0.3	1.050 1.048 0.2	1.145 1.143 0.2	1.289 1.287 0.2	1.144 1.141 0.4	1.050 1.045 0.5	1.248 1.245 0.4	0.787 0.784 0.2	0.469 0.472 -0.3		
13				0.469 0.467 0.2	1.090 1.084 0.5	1.304 1.298 0.7	1.078 1.072 0.5	1.113 1.106 0.7	1.079 1.068 1.1	1.305 1.288 1.7	1.089 1.080 0.9	0.468 0.466 0.3			
14					0.475 0.470 0.5	0.947 0.940 0.7	1.117 1.108 0.9	0.977 0.967 1.0	1.122 1.103 1.9	0.948 0.934 1.4	0.475 0.470 0.5				
15							0.396 0.392 0.3	0.467 0.462 0.5	0.397 0.392 0.6						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-21: Plant A BOC 3 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.321 0.320 0.1	0.505 0.507 -0.3	0.321 0.319 0.2						
2					0.307 0.305 0.3	0.564 0.560 0.4	1.158 1.148 1.0	1.256 1.240 1.6	1.157 1.142 1.5	0.563 0.557 0.5	0.306 0.305 0.2				
3				0.334 0.336 -0.2	1.061 1.050 1.1	1.277 1.266 1.0	1.289 1.283 0.6	1.315 1.283 3.2	1.286 1.267 1.9	1.273 1.259 1.4	1.056 1.052 0.4	0.332 0.342 -1.0			
4			0.332 0.329 0.4	0.670 0.662 0.7	1.225 1.205 2.1	1.175 1.163 1.3	1.211 1.201 1.0	1.256 1.244 1.2	1.192 1.180 1.2	1.169 1.154 1.5	1.218 1.212 0.6	0.670 0.671 -0.1	0.334 0.335 -0.1		
5		0.306 0.303 0.4	1.056 1.043 1.3	1.218 1.205 1.4	1.160 1.147 1.3	0.987 0.979 0.8	1.375 1.365 1.0	0.967 0.964 0.3	1.374 1.369 0.5	0.985 0.982 0.4	1.159 1.158 0.1	1.225 1.226 -0.1	1.061 1.064 -0.3	0.307 0.311 -0.3	
6		0.563 0.556 0.7	1.273 1.258 1.6	1.170 1.157 1.2	0.986 0.980 0.6	1.321 1.313 0.8	1.211 1.206 0.4	1.233 1.238 -0.5	1.218 1.222 -0.4	1.320 1.321 -0.1	0.987 0.989 -0.2	1.175 1.177 -0.2	1.277 1.282 -0.5	0.564 0.569 -0.5	
7	0.321 0.319 0.2	1.157 1.144 1.3	1.286 1.267 1.9	1.192 1.179 1.3	1.375 1.364 1.1	1.219 1.212 0.7	1.024 1.019 0.4	1.347 1.353 -0.6	1.022 1.037 -1.5	1.210 1.219 -0.9	1.375 1.381 -0.6	1.210 1.212 -0.2	1.289 1.294 -0.5	1.158 1.173 -1.5	0.321 0.325 -0.4
8	0.505 0.508 -0.3	1.256 1.246 1.0	1.315 1.299 1.6	1.256 1.243 1.3	0.968 0.960 0.7	1.235 1.230 0.4	1.353 1.352 0.1	0.988 0.994 -0.6	1.347 1.359 -1.2	1.233 1.250 -1.8	0.967 0.973 -0.7	1.256 1.258 -0.2	1.315 1.313 0.2	1.256 1.257 -0.2	0.505 0.509 -0.4
9	0.321 0.320 0.1	1.158 1.149 1.0	1.289 1.277 1.2	1.211 1.201 1.0	1.375 1.367 0.8	1.212 1.210 0.1	1.026 1.030 -0.5	1.353 1.359 -0.6	1.023 1.030 -0.6	1.218 1.229 -1.1	1.374 1.380 -0.6	1.191 1.193 -0.2	1.286 1.290 -0.4	1.157 1.166 -0.9	0.321 0.332 -1.1
10		0.564 0.559 0.5	1.277 1.266 1.1	1.175 1.167 0.8	0.987 0.983 0.4	1.321 1.325 -0.4	1.220 1.233 -1.3	1.234 1.242 -0.7	1.211 1.216 -0.5	1.320 1.323 -0.3	0.985 0.986 -0.1	1.169 1.166 0.3	1.273 1.278 -0.5	0.563 0.573 -1.1	
11		0.307 0.306 0.2	1.061 1.057 0.4	1.225 1.220 0.5	1.159 1.151 0.9	0.985 0.991 -0.6	1.375 1.392 -1.7	0.967 0.973 -0.6	1.375 1.380 -0.5	0.987 0.984 0.3	1.159 1.153 0.6	1.218 1.216 0.2	1.056 1.061 -0.5	0.306 0.310 -0.3	
12			0.334 0.341 -0.7	0.670 0.672 -0.2	1.218 1.223 -0.5	1.170 1.184 -1.4	1.192 1.223 -3.1	1.256 1.273 -1.7	1.210 1.220 -1.0	1.175 1.180 -0.5	1.225 1.226 -0.1	0.670 0.667 0.3	0.332 0.344 -1.2		
13				0.332 0.335 -0.2	1.056 1.065 -0.9	1.273 1.290 -1.7	1.286 1.308 -2.2	1.315 1.334 -1.9	1.289 1.304 -1.5	1.277 1.291 -1.5	1.061 1.066 -0.6	0.334 0.335 -0.1			
14					0.306 0.310 -0.4	0.563 0.571 -0.8	1.157 1.175 -1.7	1.256 1.273 -1.8	1.158 1.173 -1.4	0.564 0.570 -0.7	0.307 0.310 -0.2				
15							0.321 0.326 -0.5	0.505 0.512 -0.7	0.321 0.325 -0.4						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure A 10.4.1-22: Plant A MOC 3 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.347 0.345 0.2	0.534 0.529 0.5	0.347 0.344 0.3						
2					0.334 0.333 0.0	0.590 0.589 0.0	1.150 1.147 0.3	1.277 1.264 1.3	1.150 1.139 1.1	0.589 0.588 0.2	0.333 0.332 0.1				
3				0.366 0.373 -0.7	1.060 1.059 0.0	1.308 1.309 -0.1	1.202 1.207 -0.5	1.204 1.182 2.2	1.200 1.186 1.4	1.307 1.294 1.2	1.058 1.054 0.4	0.364 0.374 -1.0			
4			0.364 0.363 0.1	0.713 0.712 0.1	1.279 1.270 0.9	1.143 1.142 0.2	1.138 1.138 0.0	1.156 1.142 1.4	1.123 1.113 1.0	1.140 1.122 1.8	1.274 1.267 0.7	0.713 0.715 -0.2	0.366 0.366 -0.1		
5		0.333 0.332 0.1	1.058 1.054 0.4	1.274 1.272 0.2	1.153 1.151 0.1	1.003 1.005 -0.2	1.403 1.414 -1.0	0.965 0.966 -0.1	1.403 1.404 -0.1	1.002 1.002 -0.1	1.153 1.151 0.2	1.279 1.283 -0.4	1.060 1.061 -0.2	0.334 0.336 -0.2	
6		0.589 0.587 0.3	1.307 1.301 0.5	1.140 1.138 0.2	1.002 1.006 -0.5	1.386 1.389 -0.3	1.190 1.195 -0.5	1.191 1.197 -0.7	1.196 1.207 -1.2	1.386 1.408 -2.2	1.003 1.007 -0.4	1.143 1.141 0.3	1.308 1.307 0.1	0.590 0.592 -0.3	
7	0.347 0.346 0.0	1.150 1.143 0.7	1.200 1.192 0.8	1.123 1.119 0.4	1.403 1.403 0.0	1.196 1.197 -0.1	1.029 1.028 0.1	1.387 1.397 -0.9	1.028 1.048 -2.0	1.190 1.201 -1.1	1.403 1.402 0.2	1.138 1.121 1.7	1.202 1.196 0.5	1.150 1.160 -1.0	0.347 0.349 -0.3
8	0.534 0.538 -0.4	1.277 1.269 0.8	1.203 1.186 1.7	1.156 1.149 0.7	0.965 0.965 0.0	1.191 1.192 0.0	1.391 1.392 -0.1	1.029 1.035 -0.6	1.387 1.398 -1.1	1.191 1.195 -0.5	0.965 0.964 0.1	1.156 1.146 1.0	1.204 1.190 1.3	1.277 1.273 0.4	0.534 0.537 -0.2
9	0.347 0.347 0.0	1.150 1.145 0.5	1.202 1.196 0.6	1.138 1.134 0.4	1.403 1.401 0.2	1.190 1.190 0.0	1.031 1.032 -0.2	1.391 1.395 -0.4	1.029 1.036 -0.7	1.196 1.202 -0.6	1.403 1.401 0.2	1.123 1.116 0.7	1.200 1.195 0.6	1.150 1.151 -0.1	0.347 0.357 -1.0
10		0.590 0.589 0.0	1.308 1.311 -0.3	1.143 1.142 0.1	1.003 1.001 0.2	1.386 1.384 0.1	1.196 1.197 -0.1	1.191 1.193 -0.2	1.190 1.192 -0.2	1.386 1.385 0.1	1.001 0.998 0.4	1.140 1.129 1.1	1.307 1.303 0.4	0.589 0.594 -0.4	
11		0.334 0.334 -0.1	1.060 1.064 -0.4	1.278 1.278 0.0	1.152 1.146 0.7	1.001 1.000 0.1	1.403 1.403 0.0	0.965 0.965 0.0	1.403 1.403 0.0	1.003 0.998 0.4	1.152 1.145 0.7	1.274 1.268 0.7	1.058 1.058 0.0	0.333 0.334 -0.1	
12			0.365 0.376 -1.1	0.713 0.716 -0.3	1.274 1.273 0.1	1.140 1.140 0.0	1.123 1.124 -0.1	1.156 1.158 -0.3	1.138 1.141 -0.4	1.143 1.148 -0.4	1.279 1.279 -0.1	0.713 0.711 0.3	0.364 0.376 -1.2		
13				0.364 0.365 -0.1	1.057 1.058 -0.1	1.307 1.309 -0.2	1.200 1.204 -0.3	1.204 1.209 -0.5	1.202 1.211 -0.9	1.308 1.327 -1.9	1.060 1.067 -0.7	0.366 0.367 -0.1			
14					0.333 0.335 -0.2	0.589 0.592 -0.2	1.150 1.154 -0.4	1.277 1.283 -0.6	1.150 1.158 -0.8	0.590 0.596 -0.6	0.334 0.336 -0.3				
15							0.347 0.349 -0.2	0.534 0.537 -0.3	0.347 0.349 -0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure A 10.4.1-23: Plant A EOC 3 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.396 0.399 -0.3	0.586 0.598 -1.2	0.396 0.397 -0.1						
2					0.387 0.386 0.0	0.643 0.643 0.0	1.158 1.159 -0.2	1.270 1.265 0.5	1.158 1.151 0.7	0.643 0.638 0.5	0.386 0.384 0.2				
3				0.424 0.430 -0.6	1.077 1.076 0.1	1.298 1.299 -0.1	1.172 1.178 -0.6	1.165 1.142 2.3	1.170 1.158 1.3	1.298 1.285 1.2	1.076 1.071 0.5	0.423 0.432 -0.9			
4			0.423 0.421 0.3	0.770 0.767 0.3	1.273 1.263 0.9	1.126 1.123 0.3	1.110 1.108 0.2	1.124 1.113 1.1	1.097 1.088 0.9	1.124 1.109 1.5	1.270 1.261 0.9	0.770 0.768 0.2	0.424 0.422 0.2		
5		0.386 0.382 0.4	1.076 1.069 0.7	1.270 1.262 0.8	1.143 1.136 0.6	1.009 1.006 0.3	1.356 1.354 0.2	0.972 0.968 0.4	1.355 1.353 0.2	1.008 1.005 0.2	1.143 1.135 0.8	1.273 1.266 0.7	1.077 1.070 0.7	0.387 0.385 0.1	
6		0.643 0.634 0.9	1.297 1.279 1.8	1.124 1.114 1.0	1.008 1.003 0.5	1.333 1.330 0.3	1.151 1.150 0.1	1.150 1.148 0.2	1.155 1.164 -1.0	1.333 1.348 -1.5	1.009 1.008 0.1	1.126 1.118 0.8	1.298 1.287 1.1	0.643 0.638 0.5	
7	0.396 0.393 0.3	1.158 1.141 1.7	1.170 1.141 3.0	1.097 1.085 1.1	1.355 1.350 0.4	1.155 1.154 0.0	1.018 1.021 -0.2	1.326 1.338 -1.2	1.018 1.047 -2.9	1.151 1.163 -1.2	1.356 1.354 0.2	1.110 1.095 1.5	1.172 1.157 1.5	1.158 1.148 0.9	0.396 0.393 0.3
8	0.586 0.590 -0.5	1.270 1.260 0.9	1.165 1.152 1.3	1.124 1.118 0.6	0.972 0.975 -0.3	1.150 1.154 -0.4	1.328 1.334 -0.7	1.025 1.034 -0.9	1.326 1.344 -1.8	1.150 1.157 -0.7	0.972 0.970 0.2	1.124 1.112 1.2	1.165 1.140 2.4	1.270 1.263 0.6	0.586 0.583 0.3
9	0.396 0.396 0.0	1.158 1.153 0.4	1.172 1.168 0.4	1.110 1.110 0.0	1.355 1.362 -0.7	1.151 1.156 -0.5	1.019 1.024 -0.5	1.328 1.339 -1.1	1.018 1.031 -1.2	1.155 1.161 -0.7	1.355 1.355 0.0	1.097 1.092 0.5	1.170 1.162 0.9	1.158 1.154 0.4	0.396 0.394 0.2
10		0.643 0.642 0.1	1.298 1.300 -0.3	1.126 1.128 -0.2	1.009 1.011 -0.2	1.332 1.337 -0.5	1.155 1.158 -0.4	1.150 1.158 -0.8	1.151 1.160 -1.0	1.333 1.340 -0.8	1.008 1.007 0.0	1.124 1.122 0.2	1.298 1.297 0.1	0.643 0.647 -0.4	
11		0.387 0.388 -0.1	1.077 1.084 -0.7	1.273 1.276 -0.4	1.143 1.139 0.3	1.008 1.012 -0.5	1.355 1.367 -1.3	0.972 0.980 -0.8	1.355 1.367 -1.2	1.009 1.019 -1.0	1.143 1.136 0.7	1.270 1.270 0.1	1.076 1.080 -0.4	0.386 0.388 -0.2	
12			0.424 0.438 -1.4	0.770 0.776 -0.6	1.270 1.276 -0.5	1.124 1.134 -1.0	1.097 1.119 -2.2	1.124 1.137 -1.3	1.110 1.118 -0.8	1.126 1.131 -0.5	1.273 1.273 0.0	0.770 0.772 -0.2	0.423 0.436 -1.2		
13				0.423 0.426 -0.2	1.076 1.081 -0.5	1.297 1.308 -1.0	1.170 1.183 -1.2	1.165 1.174 -1.0	1.172 1.178 -0.6	1.298 1.299 -0.1	1.077 1.078 -0.1	0.424 0.425 -0.1			
14					0.386 0.384 0.2	0.643 0.646 -0.4	1.158 1.166 -0.8	1.270 1.278 -0.8	1.158 1.164 -0.6	0.643 0.644 -0.2	0.387 0.387 0.0				
15							0.396 0.397 0.0	0.586 0.589 -0.3	0.396 0.398 -0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.9

Figure A 10.4.1-24: Plant A BOC 4 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.307 0.300 0.7	0.396 0.385 1.1	0.309 0.300 0.8						
2					0.362 0.356 0.6	0.668 0.655 1.2	1.124 1.103 2.2	1.212 1.186 2.6	1.126 1.096 2.9	0.672 0.641 3.0	0.363 0.353 1.0				
3				0.376 0.372 0.4	1.094 1.075 1.9	1.289 1.267 2.2	1.286 1.264 2.2	1.316 1.293 2.2	1.287 1.261 2.6	1.291 1.262 2.9	1.096 1.078 1.8	0.377 0.373 0.3			
4			0.377 0.368 0.9	0.818 0.801 1.7	1.219 1.196 2.2	1.229 1.207 2.2	1.258 1.238 2.0	1.271 1.253 1.8	1.256 1.237 1.9	1.230 1.206 2.4	1.222 1.209 1.2	0.817 0.817 0.0	0.376 0.379 -0.2		
5		0.364 0.355 0.9	1.097 1.070 2.8	1.223 1.192 3.1	0.936 0.904 3.2	1.147 1.125 2.3	1.174 1.158 1.6	1.227 1.217 0.9	1.170 1.162 0.9	1.146 1.139 0.7	0.935 0.934 0.1	1.217 1.232 -1.5	1.093 1.107 -1.4	0.362 0.364 -0.1	
6		0.672 0.657 1.5	1.292 1.263 2.9	1.231 1.204 2.7	1.148 1.123 2.5	0.932 0.916 1.6	1.266 1.253 1.4	1.037 1.044 -0.7	1.261 1.261 0.0	0.929 0.934 -0.5	1.146 1.156 -1.1	1.227 1.245 -1.7	1.288 1.309 -2.1	0.667 0.677 -1.0	
7	0.309 0.302 0.7	1.126 1.103 2.3	1.288 1.259 2.9	1.258 1.235 2.3	1.173 1.154 1.8	1.266 1.248 1.9	0.991 0.971 2.1	1.243 1.238 0.5	0.984 0.981 0.3	1.262 1.276 -1.4	1.172 1.189 -1.7	1.257 1.280 -2.3	1.285 1.314 -2.8	1.124 1.143 -1.9	0.307 0.312 -0.5
8	0.397 0.385 1.1	1.212 1.192 2.1	1.317 1.296 2.1	1.272 1.257 1.5	1.229 1.220 1.0	1.041 1.034 0.8	1.257 1.249 0.8	1.033 1.032 0.1	1.237 1.241 -0.4	1.035 1.059 -2.4	1.226 1.250 -2.4	1.270 1.300 -3.0	1.315 1.362 -4.7	1.211 1.244 -3.2	0.396 0.406 -0.9
9	0.307 0.302 0.5	1.125 1.111 1.3	1.287 1.275 1.1	1.259 1.253 0.6	1.176 1.178 -0.2	1.270 1.272 -0.2	0.994 0.997 -0.3	1.251 1.253 -0.2	0.987 0.979 0.8	1.261 1.281 -2.0	1.170 1.191 -2.1	1.256 1.283 -2.7	1.286 1.320 -3.3	1.125 1.154 -2.9	0.308 0.316 -0.7
10		0.667 0.663 0.4	1.289 1.286 0.3	1.229 1.229 0.0	1.148 1.152 -0.4	0.933 0.940 -0.7	1.267 1.288 -2.1	1.040 1.052 -1.2	1.266 1.278 -1.2	0.930 0.944 -1.4	1.146 1.164 -1.8	1.230 1.250 -2.0	1.291 1.319 -2.8	0.671 0.686 -1.5	
11		0.362 0.362 0.0	1.094 1.098 -0.4	1.219 1.224 -0.5	0.937 0.941 -0.4	1.148 1.160 -1.2	1.173 1.191 -1.8	1.228 1.254 -2.5	1.174 1.192 -1.8	1.147 1.173 -2.6	0.935 0.944 -0.9	1.222 1.242 -2.0	1.096 1.118 -2.2	0.363 0.370 -0.7	
12			0.376 0.385 -0.9	0.818 0.826 -0.7	1.223 1.236 -1.2	1.231 1.246 -1.5	1.258 1.277 -2.0	1.271 1.287 -1.6	1.258 1.269 -1.2	1.228 1.238 -0.9	1.218 1.229 -1.1	0.817 0.833 -1.5	0.377 0.385 -0.8		
13				0.377 0.381 -0.4	1.097 1.111 -1.4	1.292 1.307 -1.5	1.287 1.301 -1.4	1.316 1.323 -0.7	1.286 1.288 -0.3	1.288 1.278 1.0	1.093 1.094 -0.1	0.376 0.379 -0.3			
14					0.364 0.372 -0.8	0.672 0.680 -0.8	1.126 1.137 -1.1	1.212 1.219 -0.7	1.124 1.126 -0.2	0.667 0.664 0.3	0.362 0.362 0.1				
15							0.309 0.313 -0.4	0.396 0.399 -0.2	0.307 0.308 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.7

Figure A 10.4.1-25: Plant A MOC 4 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.319 0.321 -0.2	0.416 0.422 -0.6	0.321 0.322 -0.1						
2					0.381 0.382 -0.1	0.661 0.664 -0.2	1.107 1.112 -0.4	1.262 1.266 -0.4	1.108 1.106 0.2	0.664 0.655 0.9	0.381 0.378 0.3				
3				0.403 0.406 -0.2	1.133 1.138 -0.4	1.339 1.343 -0.4	1.157 1.161 -0.4	1.359 1.364 -0.6	1.157 1.155 0.3	1.340 1.331 0.9	1.135 1.129 0.5	0.404 0.405 -0.2			
4			0.403 0.403 0.0	0.846 0.847 0.0	1.324 1.329 -0.5	1.163 1.165 -0.2	1.083 1.084 -0.1	1.070 1.063 0.6	1.082 1.077 0.5	1.164 1.154 1.0	1.327 1.321 0.6	0.847 0.843 0.4	0.403 0.401 0.2		
5		0.381 0.380 0.1	1.134 1.132 0.3	1.326 1.321 0.5	0.998 0.986 1.2	1.308 1.307 0.1	1.075 1.080 -0.5	1.057 1.058 -0.2	1.073 1.071 0.2	1.308 1.305 0.3	0.998 0.998 0.0	1.324 1.314 1.0	1.133 1.128 0.6	0.381 0.380 0.1	
6		0.664 0.664 0.0	1.339 1.338 0.2	1.163 1.161 0.3	1.308 1.304 0.4	0.995 0.995 0.0	1.374 1.380 -0.6	1.010 1.019 -0.9	1.372 1.371 0.0	0.994 0.994 0.1	1.308 1.308 0.0	1.163 1.159 0.4	1.339 1.334 0.5	0.662 0.658 0.3	
7	0.321 0.321 0.0	1.108 1.109 -0.1	1.157 1.157 0.0	1.082 1.082 0.0	1.073 1.072 0.0	1.373 1.375 -0.2	1.011 1.013 -0.2	1.308 1.309 -0.1	1.007 0.997 0.9	1.373 1.376 -0.3	1.074 1.076 -0.2	1.083 1.082 0.0	1.157 1.154 0.4	1.108 1.101 0.7	0.319 0.318 0.1
8	0.416 0.416 -0.1	1.262 1.265 -0.3	1.358 1.363 -0.5	1.069 1.071 -0.2	1.057 1.058 -0.2	1.011 1.014 -0.2	1.317 1.320 -0.3	1.033 1.033 0.0	1.304 1.302 0.2	1.009 1.025 -1.6	1.057 1.062 -0.5	1.070 1.070 0.0	1.359 1.357 0.2	1.262 1.266 -0.4	0.416 0.418 -0.2
9	0.319 0.320 -0.1	1.107 1.110 -0.4	1.157 1.161 -0.4	1.082 1.085 -0.3	1.075 1.077 -0.2	1.376 1.381 -0.5	1.012 1.018 -0.5	1.313 1.312 0.1	1.008 0.995 1.3	1.372 1.399 -2.7	1.073 1.078 -0.5	1.082 1.079 0.3	1.158 1.156 0.2	1.108 1.113 -0.5	0.321 0.328 -0.7
10		0.660 0.663 -0.3	1.338 1.345 -0.7	1.163 1.165 -0.2	1.308 1.309 0.0	0.995 1.000 -0.4	1.374 1.395 -2.2	1.011 1.015 -0.4	1.374 1.375 -0.1	0.995 1.002 -0.7	1.308 1.302 0.6	1.164 1.148 1.5	1.340 1.334 0.6	0.664 0.670 -0.5	
11		0.380 0.382 -0.2	1.133 1.138 -0.6	1.323 1.324 0.0	0.997 0.988 0.9	1.308 1.307 0.1	1.073 1.076 -0.4	1.057 1.056 0.1	1.075 1.078 -0.4	1.308 1.326 -1.7	0.998 0.982 1.6	1.327 1.314 1.3	1.135 1.128 0.6	0.381 0.381 0.0	
12			0.403 0.412 -0.9	0.846 0.848 -0.1	1.326 1.323 0.3	1.163 1.161 0.2	1.082 1.078 0.4	1.069 1.068 0.1	1.083 1.082 0.0	1.163 1.162 0.1	1.324 1.315 0.9	0.847 0.844 0.3	0.404 0.404 -0.1		
13				0.403 0.404 0.0	1.134 1.134 0.0	1.339 1.338 0.1	1.157 1.156 0.1	1.359 1.357 0.1	1.157 1.154 0.3	1.338 1.328 1.0	1.133 1.125 0.8	0.403 0.401 0.2			
14					0.381 0.384 -0.3	0.664 0.665 -0.1	1.108 1.109 -0.1	1.262 1.261 0.0	1.107 1.105 0.2	0.661 0.657 0.4	0.380 0.378 0.2				
15							0.321 0.325 -0.5	0.416 0.416 -0.1	0.319 0.319 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-26: Plant A EOC 4 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.360 0.365 -0.6	0.460 0.471 -1.1	0.363 0.367 -0.4						
2					0.426 0.427 -0.1	0.698 0.703 -0.5	1.105 1.117 -1.2	1.245 1.255 -0.9	1.106 1.111 -0.5	0.700 0.700 0.1	0.426 0.426 0.0				
3				0.450 0.457 -0.7	1.131 1.131 0.0	1.308 1.315 -0.8	1.117 1.134 -1.8	1.331 1.334 -0.3	1.117 1.119 -0.2	1.308 1.307 0.1	1.132 1.131 0.1	0.450 0.447 0.3			
4			0.450 0.448 0.2	0.869 0.865 0.4	1.293 1.278 1.5	1.127 1.127 0.0	1.055 1.063 -0.7	1.043 1.047 -0.4	1.055 1.057 -0.2	1.128 1.125 0.3	1.295 1.296 -0.1	0.869 0.864 0.5	0.450 0.447 0.3		
5		0.426 0.424 0.2	1.131 1.127 0.4	1.294 1.289 0.5	1.015 1.009 0.6	1.329 1.330 -0.2	1.060 1.068 -0.8	1.040 1.048 -0.8	1.059 1.064 -0.5	1.329 1.335 -0.7	1.015 1.028 -1.3	1.294 1.278 1.6	1.131 1.122 0.9	0.426 0.422 0.4	
6		0.700 0.698 0.3	1.308 1.303 0.5	1.127 1.125 0.2	1.328 1.328 0.0	1.018 1.021 -0.3	1.356 1.367 -1.1	1.013 1.030 -1.7	1.356 1.361 -0.6	1.018 1.023 -0.5	1.329 1.337 -0.8	1.128 1.126 0.2	1.308 1.303 0.5	0.698 0.696 0.2	
7	0.363 0.362 0.1	1.106 1.102 0.4	1.116 1.111 0.6	1.054 1.054 0.1	1.058 1.062 -0.4	1.355 1.361 -0.6	1.020 1.025 -0.5	1.299 1.304 -0.5	1.018 1.008 1.0	1.357 1.366 -0.9	1.060 1.067 -0.7	1.056 1.062 -0.6	1.117 1.115 0.1	1.105 1.104 0.1	0.360 0.361 0.0
8	0.460 0.459 0.2	1.245 1.241 0.4	1.331 1.328 0.3	1.043 1.045 -0.2	1.039 1.051 -1.1	1.013 1.018 -0.5	1.303 1.308 -0.6	1.046 1.049 -0.2	1.297 1.300 -0.3	1.013 1.038 -2.5	1.040 1.049 -0.9	1.043 1.045 -0.2	1.331 1.326 0.5	1.245 1.248 -0.3	0.460 0.463 -0.3
9	0.360 0.359 0.1	1.105 1.101 0.4	1.116 1.113 0.3	1.055 1.055 0.0	1.059 1.061 -0.1	1.356 1.361 -0.5	1.021 1.024 -0.4	1.301 1.301 0.0	1.019 1.011 0.8	1.356 1.357 -0.1	1.059 1.059 0.0	1.055 1.053 0.1	1.117 1.116 0.1	1.106 1.111 -0.5	0.363 0.369 -0.6
10		0.697 0.695 0.3	1.307 1.301 0.7	1.127 1.125 0.2	1.328 1.329 -0.1	1.018 1.021 -0.3	1.355 1.366 -1.1	1.013 1.014 -0.1	1.356 1.350 0.7	1.018 1.012 0.6	1.329 1.321 0.7	1.128 1.121 0.7	1.308 1.307 0.1	0.700 0.708 -0.7	
11		0.426 0.425 0.1	1.131 1.129 0.2	1.293 1.291 0.2	1.014 1.013 0.1	1.328 1.330 -0.2	1.058 1.061 -0.3	1.040 1.042 -0.2	1.060 1.053 0.7	1.329 1.309 2.0	1.015 1.005 1.0	1.295 1.287 0.8	1.132 1.128 0.3	0.426 0.427 -0.1	
12			0.450 0.453 -0.2	0.869 0.869 0.0	1.294 1.293 0.1	1.127 1.127 0.1	1.054 1.054 0.0	1.043 1.038 0.5	1.055 1.048 0.8	1.127 1.116 1.2	1.294 1.282 1.2	0.869 0.864 0.5	0.450 0.449 0.1		
13				0.450 0.450 0.0	1.131 1.129 0.2	1.308 1.305 0.3	1.116 1.111 0.5	1.331 1.313 1.8	1.116 1.109 0.8	1.308 1.296 1.2	1.131 1.122 1.0	0.450 0.447 0.3			
14					0.426 0.425 0.1	0.700 0.699 0.2	1.106 1.103 0.3	1.245 1.240 0.5	1.105 1.109 -0.4	0.697 0.695 0.3	0.426 0.423 0.3				
15							0.363 0.366 -0.3	0.460 0.460 0.0	0.360 0.361 -0.1						

Calculated Power
Measured Power
Difference (C-M)*100

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-27: Plant A BOC 5 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.303 0.302 0.1	0.389 0.396 -0.7	0.300 0.299 0.1						
2					0.327 0.323 0.5	0.670 0.663 0.8	1.166 1.158 0.9	1.259 1.250 0.9	1.160 1.151 0.9	0.661 0.655 0.6	0.326 0.324 0.3				
3				0.328 0.330 -0.2	1.081 1.065 1.6	1.271 1.255 1.6	1.301 1.290 1.1	0.903 0.888 1.5	1.298 1.284 1.3	1.266 1.256 0.9	1.078 1.070 0.8	0.328 0.328 -0.1			
4			0.328 0.325 0.3	0.777 0.766 1.1	1.218 1.189 2.9	1.262 1.241 2.1	1.131 1.114 1.7	1.110 1.090 2.0	1.132 1.118 1.4	1.260 1.254 0.6	1.216 1.205 1.1	0.776 0.770 0.7	0.328 0.325 0.2		
5		0.326 0.325 0.1	1.078 1.075 0.3	1.217 1.205 1.2	0.897 0.875 2.2	1.315 1.294 2.1	1.198 1.178 2.0	1.322 1.302 2.0	1.198 1.181 1.7	1.314 1.298 1.5	0.896 0.881 1.5	1.216 1.203 1.3	1.079 1.073 0.6	0.326 0.332 -0.5	
6		0.661 0.660 0.1	1.266 1.265 0.2	1.261 1.256 0.5	1.315 1.311 0.4	1.197 1.185 1.2	1.194 1.179 1.5	1.234 1.218 1.6	1.193 1.173 2.0	1.194 1.178 1.7	1.313 1.297 1.6	1.260 1.247 1.3	1.269 1.261 0.8	0.668 0.667 0.1	
7	0.300 0.300 0.0	1.160 1.160 0.0	1.298 1.300 -0.3	1.132 1.129 0.3	1.198 1.194 0.4	1.194 1.186 0.8	1.171 1.160 1.1	1.309 1.290 1.9	1.167 1.137 3.1	1.191 1.175 1.7	1.196 1.183 1.3	1.129 1.116 1.3	1.298 1.290 0.9	1.164 1.165 -0.1	0.302 0.302 0.0
8	0.389 0.391 -0.2	1.259 1.257 0.2	0.903 0.893 1.0	1.110 1.106 0.4	1.322 1.320 0.2	1.234 1.230 0.4	1.309 1.303 0.6	0.911 0.903 0.7	1.300 1.286 1.4	1.230 1.224 0.6	1.320 1.314 0.6	1.108 1.100 0.8	0.902 0.890 1.2	1.257 1.253 0.4	0.389 0.390 -0.1
9	0.303 0.303 -0.1	1.166 1.169 -0.3	1.300 1.304 -0.3	1.131 1.132 -0.2	1.198 1.198 -0.1	1.193 1.193 0.0	1.167 1.168 0.0	1.300 1.300 0.0	1.164 1.158 0.6	1.190 1.203 -1.2	1.196 1.199 -0.4	1.130 1.131 -0.1	1.296 1.294 0.2	1.159 1.158 0.0	0.299 0.310 -1.1
10		0.669 0.675 -0.5	1.271 1.287 -1.7	1.261 1.269 -0.8	1.314 1.318 -0.4	1.195 1.200 -0.5	1.192 1.199 -0.8	1.230 1.242 -1.2	1.190 1.201 -1.1	1.193 1.208 -1.5	1.312 1.321 -0.9	1.259 1.270 -1.1	1.265 1.268 -0.3	0.660 0.652 0.8	
11		0.327 0.331 -0.4	1.080 1.096 -1.6	1.217 1.227 -1.0	0.896 0.894 0.2	1.313 1.324 -1.1	1.197 1.213 -1.6	1.320 1.351 -3.1	1.196 1.218 -2.3	1.312 1.346 -3.4	0.895 0.894 0.1	1.215 1.226 -1.2	1.077 1.086 -0.9	0.326 0.326 0.0	
12			0.328 0.343 -1.5	0.776 0.786 -1.0	1.215 1.227 -1.2	1.260 1.275 -1.5	1.131 1.150 -2.0	1.108 1.127 -1.9	1.129 1.150 -2.1	1.259 1.285 -2.5	1.215 1.235 -1.9	0.775 0.794 -1.8	0.327 0.339 -1.1		
13				0.327 0.331 -0.4	1.077 1.091 -1.3	1.265 1.283 -1.8	1.296 1.317 -2.1	0.902 0.908 -0.6	1.298 1.321 -2.4	1.268 1.294 -2.6	1.079 1.098 -2.0	0.327 0.334 -0.6			
14					0.326 0.330 -0.4	0.660 0.671 -1.1	1.159 1.185 -2.6	1.257 1.282 -2.5	1.164 1.190 -2.7	0.667 0.680 -1.4	0.326 0.332 -0.6				
15							0.299 0.320 -2.1	0.389 0.399 -1.1	0.302 0.309 -0.7						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.3

Figure A 10.4.1-28: Plant A MOC 5 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.318 0.320 -0.2	0.402 0.404 -0.2	0.316 0.317 -0.1						
2					0.356 0.358 -0.2	0.695 0.699 -0.4	1.170 1.178 -0.8	1.235 1.240 -0.5	1.166 1.171 -0.5	0.687 0.691 -0.4	0.356 0.359 -0.2				
3				0.361 0.371 -1.0	1.119 1.125 -0.6	1.341 1.348 -0.7	1.378 1.390 -1.2	0.926 0.927 -0.1	1.377 1.381 -0.5	1.338 1.346 -0.8	1.118 1.126 -0.8	0.361 0.367 -0.6			
4			0.361 0.361 0.0	0.819 0.821 -0.2	1.298 1.296 0.3	1.225 1.226 -0.2	1.081 1.082 -0.2	1.051 1.044 0.6	1.082 1.083 -0.1	1.225 1.234 -0.9	1.299 1.306 -0.7	0.820 0.824 -0.4	0.361 0.362 -0.1		
5		0.356 0.356 0.1	1.118 1.116 0.2	1.298 1.298 0.0	0.929 0.924 0.5	1.365 1.366 -0.1	1.109 1.111 -0.2	1.306 1.302 0.3	1.109 1.107 0.2	1.365 1.366 -0.1	0.929 0.930 -0.1	1.299 1.302 -0.3	1.119 1.122 -0.4	0.356 0.360 -0.4	
6		0.687 0.686 0.1	1.338 1.338 0.0	1.225 1.228 -0.3	1.365 1.379 -1.4	1.109 1.113 -0.3	1.074 1.073 0.1	1.117 1.111 0.6	1.073 1.066 0.8	1.109 1.104 0.5	1.365 1.362 0.3	1.225 1.223 0.2	1.340 1.342 -0.2	0.694 0.697 -0.4	
7	0.316 0.316 -0.1	1.166 1.165 0.2	1.376 1.374 0.3	1.082 1.083 -0.2	1.109 1.115 -0.6	1.074 1.075 -0.2	1.067 1.063 0.3	1.308 1.297 1.1	1.065 1.045 2.0	1.073 1.063 1.0	1.109 1.102 0.6	1.081 1.073 0.8	1.378 1.378 -0.1	1.170 1.180 -0.9	0.318 0.321 -0.3
8	0.402 0.406 -0.4	1.235 1.232 0.2	0.926 0.918 0.8	1.051 1.051 -0.1	1.306 1.315 -0.9	1.117 1.118 -0.1	1.308 1.304 0.4	0.903 0.895 0.8	1.303 1.286 1.7	1.115 1.107 0.9	1.305 1.299 0.6	1.051 1.047 0.4	0.926 0.924 0.2	1.235 1.245 -1.0	0.402 0.408 -0.6
9	0.318 0.319 -0.1	1.170 1.170 0.0	1.378 1.378 0.0	1.081 1.081 0.0	1.109 1.109 -0.1	1.073 1.072 0.1	1.065 1.061 0.4	1.303 1.292 1.0	1.063 1.043 2.0	1.073 1.070 0.3	1.109 1.106 0.3	1.082 1.083 -0.1	1.377 1.380 -0.3	1.167 1.174 -0.7	0.316 0.330 -1.4
10		0.695 0.697 -0.2	1.341 1.348 -0.8	1.225 1.225 0.0	1.365 1.361 0.4	1.109 1.106 0.3	1.073 1.071 0.2	1.115 1.113 0.2	1.073 1.067 0.6	1.109 1.106 0.2	1.365 1.362 0.3	1.226 1.232 -0.7	1.338 1.341 -0.3	0.687 0.684 0.4	
11		0.356 0.358 -0.1	1.119 1.123 -0.4	1.299 1.296 0.3	0.929 0.916 1.3	1.365 1.359 0.6	1.109 1.109 0.0	1.305 1.315 -1.0	1.109 1.110 -0.1	1.365 1.367 -0.3	0.929 0.917 1.2	1.299 1.299 0.0	1.118 1.122 -0.4	0.356 0.356 0.0	
12			0.361 0.367 -0.6	0.819 0.818 0.1	1.299 1.292 0.7	1.225 1.220 0.5	1.082 1.080 0.2	1.051 1.050 0.1	1.081 1.080 0.1	1.225 1.225 0.1	1.299 1.295 0.4	0.819 0.820 -0.1	0.361 0.368 -0.8		
13				0.361 0.360 0.1	1.118 1.114 0.4	1.338 1.334 0.4	1.377 1.373 0.4	0.926 0.916 1.0	1.378 1.374 0.4	1.340 1.341 -0.1	1.119 1.118 0.1	0.361 0.361 0.0			
14					0.356 0.355 0.1	0.687 0.687 0.0	1.167 1.170 -0.3	1.235 1.233 0.2	1.170 1.168 0.2	0.693 0.692 0.1	0.356 0.356 0.1				
15							0.316 0.333 -1.7	0.402 0.406 -0.3	0.318 0.318 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-29: Plant A EOC 5 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.370 0.373 -0.3	0.458 0.468 -1.0	0.368 0.370 -0.3						
2					0.412 0.413 -0.1	0.733 0.734 -0.1	1.158 1.161 -0.3	1.212 1.218 -0.6	1.155 1.156 0.0	0.726 0.715 1.1	0.413 0.411 0.2				
3				0.423 0.436 -1.3	1.125 1.127 -0.2	1.289 1.291 -0.1	1.323 1.323 0.0	0.954 0.959 -0.6	1.323 1.325 -0.3	1.288 1.288 0.1	1.125 1.127 -0.2	0.423 0.431 -0.7			
4			0.423 0.421 0.3	0.867 0.867 0.1	1.281 1.271 1.0	1.177 1.178 -0.1	1.058 1.063 -0.5	1.038 1.044 -0.6	1.060 1.064 -0.4	1.177 1.181 -0.4	1.281 1.282 -0.1	0.868 0.867 0.1	0.423 0.422 0.1		
5		0.413 0.408 0.4	1.125 1.114 1.1	1.281 1.279 0.2	0.958 0.970 -1.2	1.364 1.374 -1.0	1.088 1.102 -1.5	1.278 1.289 -1.1	1.088 1.093 -0.5	1.364 1.368 -0.3	0.958 0.956 0.2	1.281 1.270 1.2	1.125 1.122 0.3	0.412 0.418 -0.6	
6		0.726 0.718 0.8	1.288 1.275 1.4	1.177 1.169 0.8	1.364 1.354 1.0	1.097 1.098 -0.2	1.062 1.069 -0.8	1.094 1.106 -1.2	1.062 1.066 -0.4	1.096 1.098 -0.1	1.364 1.363 0.1	1.177 1.173 0.4	1.289 1.286 0.3	0.731 0.730 0.2	
7	0.368 0.365 0.3	1.155 1.144 1.2	1.323 1.303 2.0	1.059 1.052 0.7	1.088 1.085 0.3	1.062 1.063 -0.2	1.054 1.058 -0.4	1.291 1.296 -0.6	1.053 1.053 0.0	1.062 1.062 0.0	1.088 1.088 0.0	1.059 1.058 0.1	1.323 1.320 0.3	1.158 1.148 1.0	0.370 0.368 0.2
8	0.458 0.458 0.1	1.212 1.205 0.7	0.954 0.951 0.2	1.038 1.037 0.1	1.278 1.281 -0.3	1.094 1.097 -0.3	1.290 1.295 -0.4	0.932 0.934 -0.2	1.288 1.289 -0.1	1.094 1.095 -0.1	1.278 1.279 -0.1	1.038 1.040 -0.1	0.954 0.958 -0.4	1.212 1.212 0.0	0.458 0.462 -0.3
9	0.370 0.369 0.1	1.158 1.152 0.5	1.323 1.318 0.5	1.058 1.058 0.0	1.088 1.096 -0.8	1.062 1.066 -0.4	1.053 1.057 -0.3	1.288 1.290 -0.2	1.053 1.053 0.0	1.062 1.063 -0.1	1.088 1.089 0.0	1.060 1.060 -0.1	1.323 1.325 -0.2	1.156 1.158 -0.3	0.368 0.383 -1.6
10		0.732 0.728 0.4	1.289 1.280 1.0	1.177 1.176 0.1	1.364 1.368 -0.4	1.097 1.100 -0.3	1.062 1.066 -0.5	1.094 1.095 0.0	1.062 1.058 0.4	1.097 1.090 0.7	1.365 1.365 0.0	1.177 1.177 0.0	1.289 1.288 0.1	0.726 0.717 0.9	
11		0.412 0.412 0.0	1.125 1.128 -0.3	1.281 1.284 -0.3	0.958 0.959 -0.1	1.365 1.366 -0.2	1.088 1.088 0.0	1.278 1.277 0.1	1.088 1.079 0.9	1.365 1.338 2.6	0.958 0.963 -0.5	1.282 1.285 -0.3	1.125 1.130 -0.5	0.413 0.412 0.1	
12			0.423 0.439 -1.5	0.867 0.873 -0.6	1.281 1.285 -0.3	1.177 1.178 -0.1	1.060 1.056 0.4	1.039 1.035 0.4	1.059 1.051 0.8	1.177 1.164 1.3	1.281 1.277 0.4	0.868 0.869 -0.2	0.423 0.435 -1.2		
13				0.423 0.425 -0.2	1.125 1.128 -0.3	1.289 1.290 -0.2	1.323 1.324 -0.1	0.954 0.952 0.2	1.323 1.313 1.0	1.289 1.274 1.5	1.125 1.117 0.8	0.423 0.422 0.1			
14					0.413 0.414 -0.1	0.726 0.729 -0.2	1.156 1.162 -0.7	1.212 1.212 0.0	1.158 1.149 0.8	0.731 0.724 0.7	0.412 0.409 0.3				
15							0.368 0.385 -1.7	0.458 0.462 -0.4	0.370 0.369 0.1						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-30: Plant A BOC 6 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.303 0.302 0.1	0.340 0.343 -0.3	0.287 0.286 0.1						
2					0.339 0.337 0.2	0.556 0.552 0.4	1.146 1.138 0.8	0.986 0.976 0.9	1.132 1.125 0.7	0.558 0.559 -0.1	0.340 0.341 -0.1				
3				0.493 0.501 -0.9	1.237 1.229 0.8	1.269 1.260 0.9	1.135 1.129 0.7	1.266 1.244 2.1	1.132 1.122 1.0	1.269 1.265 0.4	1.238 1.240 -0.2	0.493 0.502 -0.9			
4			0.493 0.486 0.7	1.320 1.309 1.1	1.369 1.351 1.8	1.151 1.138 1.3	1.234 1.220 1.4	1.153 1.138 1.6	1.235 1.226 1.0	1.152 1.145 0.7	1.370 1.373 -0.2	1.320 1.320 0.0	0.493 0.492 0.1		
5		0.339 0.333 0.6	1.237 1.215 2.3	1.370 1.356 1.4	0.893 0.885 0.8	1.097 1.086 1.1	1.281 1.265 1.7	1.141 1.133 0.8	1.282 1.278 0.4	1.098 1.098 0.0	0.892 0.903 -1.0	1.369 1.359 1.0	1.237 1.232 0.5	0.339 0.343 -0.3	
6		0.556 0.549 0.7	1.268 1.253 1.6	1.152 1.141 1.0	1.099 1.094 0.4	1.183 1.178 0.5	1.154 1.150 0.4	1.178 1.180 -0.3	1.153 1.155 -0.1	1.182 1.184 -0.2	1.096 1.098 -0.2	1.150 1.146 0.4	1.268 1.264 0.5	0.555 0.552 0.3	
7	0.287 0.286 0.1	1.131 1.120 1.1	1.131 1.117 1.4	1.235 1.225 0.9	1.282 1.279 0.3	1.154 1.154 0.0	0.861 0.867 -0.6	1.261 1.268 -0.7	0.859 0.865 -0.6	1.152 1.156 -0.4	1.280 1.282 -0.3	1.233 1.231 0.2	1.135 1.127 0.7	1.145 1.133 1.2	0.303 0.301 0.2
8	0.340 0.347 -0.7	0.985 0.977 0.8	1.265 1.250 1.5	1.153 1.146 0.7	1.141 1.142 -0.1	1.177 1.181 -0.4	1.261 1.269 -0.8	0.869 0.877 -0.8	1.255 1.267 -1.2	1.175 1.182 -0.7	1.139 1.142 -0.3	1.150 1.149 0.2	1.264 1.254 1.1	0.985 0.989 -0.5	0.340 0.343 -0.3
9	0.303 0.303 0.0	1.146 1.138 0.7	1.135 1.126 0.9	1.234 1.229 0.5	1.281 1.282 -0.2	1.152 1.157 -0.5	0.858 0.867 -0.9	1.255 1.269 -1.5	0.857 0.872 -1.5	1.152 1.161 -0.9	1.280 1.287 -0.7	1.234 1.237 -0.3	1.131 1.134 -0.3	1.132 1.143 -1.2	0.287 0.298 -1.1
10		0.556 0.552 0.4	1.269 1.261 0.8	1.150 1.149 0.2	1.096 1.099 -0.2	1.182 1.189 -0.7	1.152 1.169 -1.7	1.174 1.186 -1.2	1.150 1.162 -1.2	1.181 1.192 -1.1	1.097 1.104 -0.7	1.151 1.155 -0.4	1.269 1.281 -1.2	0.558 0.571 -1.3	
11		0.339 0.339 0.0	1.236 1.240 -0.4	1.369 1.374 -0.5	0.892 0.896 -0.4	1.097 1.102 -0.5	1.279 1.286 -0.8	1.137 1.142 -0.5	1.278 1.287 -1.0	1.095 1.111 -1.6	0.891 0.900 -0.9	1.369 1.382 -1.2	1.237 1.255 -1.8	0.340 0.346 -0.6	
12			0.493 0.507 -1.4	1.319 1.329 -1.0	1.369 1.375 -0.7	1.149 1.153 -0.4	1.231 1.232 -0.1	1.147 1.146 0.2	1.230 1.232 -0.2	1.148 1.152 -0.4	1.367 1.375 -0.8	1.319 1.326 -0.7	0.493 0.515 -2.2		
13				0.493 0.495 -0.3	1.235 1.239 -0.4	1.265 1.267 -0.2	1.126 1.124 0.2	1.258 1.245 1.3	1.130 1.125 0.5	1.265 1.260 0.4	1.235 1.236 -0.1	0.492 0.493 -0.1			
14					0.339 0.340 -0.1	0.554 0.555 -0.1	1.122 1.123 -0.1	0.973 0.969 0.4	1.136 1.135 0.1	0.553 0.551 0.2	0.338 0.338 0.0				
15							0.283 0.292 -0.9	0.330 0.331 -0.1	0.298 0.298 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-31: Plant A MOC 6 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.308 0.302 0.6	0.346 0.339 0.7	0.293 0.288 0.4						
2					0.352 0.348 0.4	0.564 0.556 0.8	1.117 1.098 1.9	0.962 0.942 2.0	1.108 1.096 1.2	0.567 0.574 -0.7	0.353 0.355 -0.2				
3				0.489 0.502 -1.2	1.224 1.215 0.9	1.334 1.319 1.5	1.095 1.078 1.7	1.382 1.339 4.3	1.093 1.077 1.6	1.335 1.332 0.3	1.225 1.231 -0.6	0.490 0.506 -1.7			
4			0.490 0.488 0.1	1.292 1.290 0.2	1.411 1.391 2.0	1.106 1.091 1.5	1.173 1.155 1.9	1.107 1.086 2.1	1.175 1.162 1.3	1.107 1.100 0.7	1.412 1.411 0.0	1.292 1.289 0.3	0.489 0.485 0.4		
5		0.353 0.352 0.0	1.225 1.226 -0.1	1.411 1.411 0.0	0.900 0.896 0.4	1.043 1.034 0.9	1.381 1.360 2.1	1.107 1.098 0.9	1.382 1.374 0.7	1.044 1.040 0.5	0.900 0.901 -0.1	1.410 1.388 2.2	1.224 1.211 1.3	0.352 0.357 -0.5	
6		0.566 0.565 0.1	1.334 1.338 -0.4	1.107 1.108 -0.1	1.045 1.046 -0.2	1.101 1.104 -0.3	1.101 1.106 -0.5	1.140 1.150 -1.0	1.101 1.102 0.0	1.101 1.098 0.2	1.043 1.037 0.6	1.105 1.092 1.4	1.334 1.316 1.8	0.564 0.554 1.0	
7	0.292 0.293 -0.1	1.108 1.105 0.3	1.093 1.098 -0.5	1.175 1.176 -0.2	1.382 1.392 -1.0	1.102 1.115 -1.3	0.902 0.931 -2.8	1.403 1.423 -2.0	0.901 0.904 -0.3	1.100 1.100 0.0	1.380 1.376 0.4	1.173 1.161 1.2	1.095 1.075 2.0	1.117 1.083 3.5	0.308 0.299 0.8
8	0.346 0.354 -0.7	0.962 0.948 1.4	1.382 1.341 4.1	1.107 1.099 0.8	1.107 1.121 -1.4	1.140 1.154 -1.4	1.403 1.427 -2.4	0.981 0.995 -1.4	1.397 1.412 -1.5	1.138 1.144 -0.6	1.106 1.105 0.0	1.105 1.097 0.8	1.381 1.357 2.5	0.962 0.946 1.6	0.346 0.343 0.4
9	0.308 0.305 0.3	1.117 1.100 1.7	1.095 1.073 2.2	1.174 1.165 0.8	1.381 1.387 -0.6	1.101 1.109 -0.8	0.901 0.911 -1.0	1.397 1.418 -2.0	0.899 0.917 -1.8	1.101 1.111 -1.0	1.381 1.387 -0.7	1.174 1.176 -0.2	1.093 1.090 0.3	1.108 1.108 0.0	0.293 0.302 -0.9
10		0.564 0.554 1.0	1.334 1.308 2.7	1.106 1.100 0.6	1.043 1.048 -0.4	1.101 1.108 -0.7	1.101 1.104 -0.3	1.138 1.152 -1.4	1.100 1.115 -1.5	1.101 1.113 -1.3	1.044 1.052 -0.8	1.107 1.120 -1.3	1.335 1.347 -1.2	0.568 0.576 -0.8	
11		0.352 0.350 0.3	1.224 1.224 -0.1	1.411 1.421 -1.1	0.900 0.916 -1.5	1.044 1.056 -1.1	1.380 1.396 -1.5	1.106 1.124 -1.8	1.380 1.397 -1.8	1.043 1.059 -1.6	0.900 0.903 -0.3	1.412 1.423 -1.1	1.225 1.240 -1.5	0.353 0.358 -0.4	
12			0.489 0.508 -1.8	1.292 1.312 -2.0	1.411 1.433 -2.1	1.106 1.120 -1.3	1.173 1.188 -1.4	1.104 1.114 -1.0	1.172 1.179 -0.6	1.105 1.109 -0.4	1.410 1.414 -0.4	1.292 1.294 -0.2	0.490 0.505 -1.5		
13				0.489 0.496 -0.6	1.224 1.241 -1.7	1.334 1.349 -1.6	1.091 1.100 -0.9	1.378 1.383 -0.5	1.094 1.089 0.4	1.333 1.326 0.7	1.223 1.221 0.2	0.489 0.488 0.2			
14					0.353 0.357 -0.4	0.566 0.571 -0.5	1.104 1.111 -0.7	0.956 0.953 0.3	1.113 1.092 2.1	0.563 0.556 0.7	0.352 0.350 0.2				
15							0.290 0.297 -0.7	0.339 0.339 0.0	0.305 0.300 0.5						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.3

Figure A 10.4.1-32: Plant A EOC 6 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.330 0.330 0.0	0.370 0.370 0.1	0.314 0.315 -0.1						
2					0.383 0.380 0.3	0.589 0.588 0.2	1.086 1.088 -0.2	0.941 0.938 0.3	1.079 1.083 -0.4	0.592 0.605 -1.3	0.384 0.390 -0.6	Calculated Power Measured Power Difference (C-M)*100			
3				0.517 0.530 -1.2	1.219 1.209 1.1	1.347 1.343 0.5	1.056 1.065 -0.9	1.388 1.371 1.8	1.055 1.056 -0.1	1.348 1.360 -1.2	1.220 1.236 -1.6	0.517 0.533 -1.5			
4			0.517 0.516 0.1	1.297 1.289 0.8	1.470 1.432 3.9	1.086 1.074 1.2	1.125 1.122 0.4	1.063 1.069 -0.6	1.126 1.132 -0.6	1.087 1.094 -0.7	1.471 1.484 -1.4	1.297 1.296 0.2	0.517 0.513 0.4		
5		0.384 0.385 -0.2	1.220 1.225 -0.5	1.471 1.471 -0.1	0.944 0.938 0.6	1.030 1.023 0.6	1.398 1.380 1.8	1.070 1.073 -0.3	1.398 1.408 -1.0	1.031 1.040 -1.0	0.944 0.963 -1.9	1.470 1.439 3.2	1.220 1.206 1.3	0.383 0.392 -0.8	
6		0.591 0.596 -0.5	1.348 1.361 -1.3	1.087 1.096 -0.9	1.031 1.050 -1.9	1.068 1.077 -0.8	1.068 1.076 -0.8	1.103 1.121 -1.8	1.068 1.079 -1.1	1.068 1.075 -0.7	1.030 1.032 -0.2	1.087 1.074 1.3	1.348 1.332 1.5	0.590 0.585 0.4	
7	0.314 0.318 -0.4	1.079 1.088 -0.9	1.055 1.074 -1.9	1.126 1.135 -0.9	1.398 1.412 -1.4	1.068 1.081 -1.3	0.924 0.948 -2.3	1.424 1.447 -2.3	0.924 0.934 -1.0	1.068 1.072 -0.4	1.398 1.396 0.2	1.126 1.114 1.1	1.056 1.040 1.6	1.086 1.074 1.2	0.330 0.327 0.3
8	0.370 0.381 -1.1	0.941 0.937 0.4	1.389 1.364 2.5	1.063 1.057 0.5	1.070 1.073 -0.3	1.103 1.111 -0.8	1.424 1.441 -1.7	1.018 1.030 -1.1	1.423 1.434 -1.1	1.103 1.105 -0.2	1.070 1.066 0.4	1.062 1.049 1.3	1.389 1.353 3.6	0.941 0.930 1.1	0.371 0.370 0.0
9	0.330 0.330 0.0	1.086 1.077 1.0	1.056 1.040 1.6	1.126 1.115 1.0	1.398 1.388 1.0	1.068 1.068 0.0	0.924 0.928 -0.4	1.423 1.433 -1.0	0.924 0.932 -0.8	1.069 1.065 0.4	1.399 1.395 0.4	1.127 1.121 0.5	1.055 1.048 0.7	1.080 1.084 -0.4	0.314 0.328 -1.4
10		0.590 0.581 0.9	1.347 1.321 2.6	1.087 1.079 0.8	1.030 1.029 0.2	1.069 1.068 0.0	1.069 1.064 0.5	1.104 1.108 -0.5	1.069 1.071 -0.2	1.069 1.067 0.2	1.031 1.032 0.0	1.088 1.090 -0.2	1.349 1.355 -0.7	0.593 0.606 -1.4	
11		0.383 0.381 0.3	1.220 1.218 0.2	1.471 1.478 -0.7	0.945 0.959 -1.4	1.031 1.037 -0.6	1.399 1.405 -0.6	1.070 1.083 -1.3	1.399 1.398 0.1	1.031 1.023 0.8	0.945 0.950 -0.5	1.471 1.473 -0.2	1.221 1.231 -1.0	0.384 0.389 -0.5	
12			0.517 0.532 -1.5	1.298 1.312 -1.4	1.472 1.487 -1.5	1.088 1.095 -0.7	1.127 1.132 -0.4	1.063 1.063 0.0	1.127 1.118 0.9	1.088 1.070 1.7	1.471 1.456 1.6	1.298 1.284 1.4	0.518 0.535 -1.7		
13				0.518 0.522 -0.4	1.221 1.231 -1.0	1.349 1.356 -0.7	1.056 1.057 -0.1	1.390 1.382 0.8	1.057 1.039 1.9	1.349 1.304 4.4	1.221 1.195 2.5	0.518 0.508 0.9			
14					0.384 0.386 -0.2	0.592 0.594 -0.2	1.078 1.080 -0.2	0.938 0.931 0.8	1.085 1.062 2.3	0.590 0.573 1.7	0.384 0.374 0.9				
15							0.313 0.322 -0.9	0.365 0.364 0.1	0.328 0.322 0.6						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.2

Figure A 10.4.1-33: Plant A BOC 7 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.269 0.263 0.5	0.337 0.330 0.6	0.270 0.265 0.5						
2					0.280 0.273 0.6	0.501 0.491 1.0	1.079 1.058 2.1	1.141 1.123 1.8	1.084 1.066 1.8	0.532 0.522 1.0	0.289 0.284 0.5				
3				0.392 0.387 0.5	1.155 1.130 2.5	1.251 1.226 2.5	1.210 1.184 2.7	1.159 1.145 1.4	1.213 1.194 1.9	1.269 1.245 2.4	1.170 1.150 2.0	0.395 0.390 0.4			
4			0.394 0.383 1.1	1.225 1.199 2.6	1.326 1.291 3.5	1.238 1.217 2.1	1.283 1.266 1.7	0.866 0.857 1.0	1.285 1.266 1.9	1.243 1.211 3.3	1.332 1.312 2.0	1.225 1.210 1.5	0.392 0.388 0.4		
5		0.289 0.282 0.8	1.169 1.132 3.8	1.332 1.308 2.3	1.234 1.218 1.5	1.242 1.233 0.9	1.178 1.173 0.5	1.302 1.300 0.2	1.179 1.172 0.7	1.244 1.230 1.4	1.234 1.223 1.1	1.327 1.315 1.2	1.156 1.145 1.0	0.280 0.272 0.8	
6		0.531 0.525 0.5	1.268 1.252 1.6	1.243 1.235 0.8	1.243 1.247 -0.3	1.254 1.262 -0.8	1.141 1.154 -1.3	1.156 1.168 -1.3	1.142 1.147 -0.5	1.254 1.254 0.1	1.242 1.238 0.4	1.238 1.233 0.6	1.251 1.247 0.4	0.501 0.497 0.4	
7	0.270 0.271 -0.1	1.084 1.083 0.1	1.213 1.211 0.2	1.285 1.288 -0.4	1.178 1.192 -1.4	1.140 1.161 -2.1	0.845 0.880 -3.5	1.317 1.345 -2.8	0.847 0.861 -1.5	1.141 1.150 -0.8	1.178 1.180 -0.2	1.284 1.281 0.2	1.211 1.214 -0.3	1.080 1.075 0.5	0.269 0.268 0.1
8	0.337 0.343 -0.6	1.142 1.146 -0.4	1.160 1.163 -0.4	0.866 0.874 -0.8	1.301 1.333 -3.2	1.153 1.177 -2.4	1.311 1.343 -3.2	0.891 0.908 -1.8	1.317 1.339 -2.2	1.155 1.171 -1.6	1.302 1.311 -0.9	0.867 0.872 -0.5	1.160 1.185 -2.5	1.142 1.145 -0.4	0.337 0.338 -0.1
9	0.269 0.271 -0.2	1.080 1.085 -0.4	1.212 1.217 -0.5	1.284 1.293 -1.0	1.178 1.193 -1.6	1.140 1.157 -1.7	0.843 0.858 -1.5	1.311 1.333 -2.2	0.845 0.860 -1.5	1.141 1.158 -1.7	1.179 1.184 -0.5	1.286 1.286 -0.1	1.215 1.223 -0.8	1.085 1.093 -0.8	0.270 0.277 -0.7
10		0.501 0.502 -0.1	1.252 1.255 -0.3	1.238 1.241 -0.3	1.242 1.247 -0.4	1.254 1.265 -1.2	1.140 1.157 -1.7	1.153 1.168 -1.5	1.140 1.152 -1.2	1.254 1.262 -0.8	1.244 1.240 0.5	1.244 1.226 1.8	1.269 1.266 0.3	0.531 0.536 -0.5	
11		0.280 0.279 0.0	1.156 1.154 0.2	1.327 1.324 0.3	1.235 1.223 1.3	1.244 1.248 -0.5	1.178 1.190 -1.2	1.301 1.315 -1.4	1.178 1.186 -0.9	1.242 1.247 -0.4	1.236 1.224 1.1	1.333 1.317 1.5	1.170 1.164 0.6	0.289 0.289 0.0	
12			0.393 0.388 0.4	1.226 1.222 0.3	1.332 1.332 0.0	1.244 1.251 -0.8	1.285 1.303 -1.8	0.866 0.874 -0.8	1.283 1.292 -0.9	1.238 1.239 -0.1	1.327 1.318 1.0	1.226 1.201 2.5	0.395 0.397 -0.2		
13				0.395 0.394 0.0	1.170 1.174 -0.4	1.268 1.279 -1.0	1.213 1.228 -1.5	1.159 1.173 -1.4	1.211 1.219 -0.9	1.251 1.254 -0.2	1.156 1.151 0.5	0.393 0.387 0.5			
14					0.289 0.291 -0.1	0.531 0.536 -0.5	1.084 1.101 -1.8	1.141 1.157 -1.6	1.080 1.090 -1.1	0.501 0.503 -0.2	0.280 0.279 0.1				
15							0.270 0.285 -1.5	0.337 0.343 -0.6	0.269 0.272 -0.3						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.4

Figure A 10.4.1-34: Plant A MOC 7 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.278 0.278 -0.1	0.349 0.350 -0.1	0.279 0.280 -0.1						
2					0.298 0.295 0.3	0.513 0.512 0.1	1.054 1.057 -0.3	1.154 1.160 -0.6	1.057 1.063 -0.7	0.541 0.551 -1.0	0.306 0.308 -0.2				
3				0.410 0.404 0.6	1.140 1.128 1.2	1.299 1.294 0.5	1.171 1.175 -0.4	1.115 1.120 -0.6	1.173 1.175 -0.2	1.313 1.314 -0.1	1.150 1.151 -0.1	0.412 0.418 -0.7			
4			0.412 0.406 0.6	1.215 1.200 1.5	1.380 1.356 2.3	1.204 1.198 0.7	1.348 1.348 -0.1	0.901 0.901 0.0	1.349 1.346 0.3	1.208 1.196 1.2	1.384 1.377 0.7	1.215 1.210 0.4	0.410 0.408 0.2		
5		0.306 0.303 0.4	1.149 1.135 1.5	1.384 1.375 0.9	1.188 1.182 0.5	1.183 1.183 0.0	1.146 1.148 -0.2	1.379 1.379 0.0	1.146 1.144 0.3	1.184 1.177 0.7	1.188 1.177 1.1	1.380 1.369 1.1	1.140 1.133 0.7	0.298 0.294 0.3	
6		0.540 0.537 0.3	1.313 1.307 0.5	1.208 1.207 0.0	1.184 1.195 -1.1	1.285 1.296 -1.1	1.099 1.109 -1.0	1.117 1.116 0.1	1.099 1.099 0.0	1.285 1.284 0.2	1.183 1.178 0.5	1.204 1.199 0.6	1.299 1.294 0.5	0.513 0.511 0.2	
7	0.279 0.280 -0.1	1.056 1.055 0.1	1.173 1.171 0.2	1.348 1.352 -0.4	1.146 1.157 -1.1	1.099 1.114 -1.5	0.853 0.880 -2.7	1.345 1.359 -1.4	0.855 0.859 -0.4	1.099 1.103 -0.4	1.146 1.146 0.0	1.348 1.345 0.3	1.171 1.169 0.2	1.054 1.055 -0.1	0.278 0.279 -0.1
8	0.349 0.358 -0.9	1.154 1.153 0.1	1.115 1.111 0.4	0.901 0.902 -0.1	1.378 1.397 -1.9	1.115 1.129 -1.3	1.342 1.362 -2.0	0.915 0.923 -0.9	1.345 1.354 -0.9	1.116 1.130 -1.4	1.378 1.383 -0.5	0.901 0.900 0.2	1.115 1.113 0.2	1.154 1.170 -1.6	0.349 0.355 -0.6
9	0.278 0.278 0.0	1.054 1.047 0.7	1.173 1.160 1.3	1.348 1.341 0.7	1.146 1.147 -0.1	1.099 1.104 -0.5	0.853 0.859 -0.6	1.342 1.351 -0.9	0.853 0.851 0.2	1.099 1.104 -0.5	1.146 1.146 0.0	1.349 1.346 0.3	1.174 1.174 0.0	1.057 1.068 -1.1	0.279 0.295 -1.6
10		0.513 0.504 0.9	1.300 1.266 3.4	1.205 1.190 1.5	1.183 1.177 0.7	1.285 1.287 -0.2	1.098 1.104 -0.5	1.115 1.127 -1.1	1.099 1.105 -0.6	1.285 1.290 -0.4	1.184 1.180 0.4	1.208 1.197 1.2	1.313 1.309 0.4	0.540 0.539 0.1	
11		0.298 0.292 0.5	1.140 1.122 1.9	1.380 1.365 1.6	1.189 1.176 1.3	1.184 1.183 0.2	1.146 1.154 -0.8	1.378 1.409 -3.1	1.146 1.157 -1.1	1.183 1.191 -0.7	1.189 1.179 1.0	1.384 1.368 1.7	1.150 1.147 0.3	0.306 0.305 0.1	
12			0.410 0.409 0.1	1.215 1.206 0.9	1.384 1.377 0.7	1.208 1.206 0.2	1.349 1.351 -0.2	0.901 0.907 -0.6	1.348 1.355 -0.7	1.205 1.204 0.1	1.380 1.365 1.5	1.215 1.181 3.4	0.412 0.424 -1.3		
13				0.412 0.409 0.3	1.150 1.146 0.3	1.313 1.313 0.0	1.173 1.176 -0.3	1.115 1.114 0.1	1.172 1.176 -0.4	1.299 1.297 0.2	1.140 1.131 0.9	0.410 0.402 0.8			
14					0.306 0.306 0.1	0.540 0.542 -0.2	1.056 1.067 -1.0	1.154 1.164 -1.0	1.054 1.067 -1.4	0.513 0.514 -0.1	0.298 0.296 0.2				
15							0.279 0.295 -1.6	0.349 0.355 -0.6	0.278 0.281 -0.3						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.9

Figure A 10.4.1-35: Plant A EOC 7 Assembly Average Radial Power Distribution

Legend: Calculated Power / Measured Power / Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.329 0.329 0.1	0.404 0.403 0.0	0.330 0.330 0.0						
2					0.357 0.357 0.1	0.567 0.565 0.1	1.056 1.057 -0.1	1.134 1.137 -0.3	1.057 1.060 -0.3	0.590 0.592 -0.2	0.364 0.366 -0.2	Calculated Power Measured Power Difference (C-M)*100			
3				0.467 0.467 0.0	1.121 1.123 -0.1	1.267 1.268 -0.1	1.142 1.140 0.2	1.098 1.100 -0.2	1.141 1.144 -0.3	1.272 1.278 -0.6	1.125 1.136 -1.0	0.467 0.482 -1.5			
4			0.467 0.468 -0.1	1.182 1.186 -0.4	1.358 1.361 -0.3	1.159 1.161 -0.2	1.366 1.368 -0.2	0.953 0.953 0.0	1.364 1.368 -0.3	1.159 1.161 -0.2	1.358 1.366 -0.7	1.182 1.191 -1.0	0.467 0.469 -0.2		
5		0.364 0.365 -0.1	1.125 1.131 -0.5	1.358 1.365 -0.6	1.145 1.150 -0.5	1.150 1.154 -0.4	1.123 1.127 -0.4	1.343 1.345 -0.2	1.123 1.123 -0.1	1.150 1.151 -0.1	1.145 1.146 -0.1	1.358 1.362 -0.4	1.121 1.126 -0.5	0.357 0.361 -0.4	
6		0.589 0.591 -0.2	1.272 1.278 -0.6	1.159 1.165 -0.6	1.150 1.160 -1.0	1.326 1.333 -0.7	1.093 1.096 -0.2	1.090 1.088 0.2	1.093 1.092 0.1	1.326 1.326 0.0	1.150 1.151 0.0	1.159 1.161 -0.2	1.267 1.270 -0.4	0.566 0.566 0.0	
7	0.330 0.332 -0.2	1.056 1.062 -0.5	1.141 1.146 -0.4	1.365 1.371 -0.6	1.123 1.127 -0.5	1.093 1.096 -0.3	0.896 0.896 0.0	1.296 1.295 0.1	0.896 0.894 0.3	1.093 1.091 0.2	1.123 1.122 0.1	1.366 1.369 -0.3	1.142 1.145 -0.3	1.056 1.053 0.3	0.329 0.326 0.4
8	0.403 0.410 -0.6	1.134 1.140 -0.6	1.098 1.100 -0.2	0.953 0.954 -0.1	1.343 1.348 -0.4	1.090 1.091 -0.1	1.295 1.294 0.0	0.941 0.938 0.2	1.296 1.293 0.3	1.090 1.083 0.7	1.343 1.342 0.1	0.953 0.953 0.0	1.098 1.108 -1.0	1.134 1.087 4.7	0.404 0.394 1.0
9	0.329 0.331 -0.1	1.056 1.058 -0.1	1.143 1.141 0.2	1.366 1.366 0.0	1.123 1.126 -0.3	1.093 1.092 0.2	0.896 0.892 0.4	1.295 1.293 0.2	0.896 0.893 0.3	1.093 1.090 0.3	1.122 1.121 0.2	1.364 1.366 -0.2	1.142 1.145 -0.3	1.056 1.052 0.4	0.330 0.344 -1.4
10		0.567 0.564 0.3	1.267 1.258 0.9	1.159 1.154 0.5	1.150 1.146 0.4	1.326 1.319 0.6	1.093 1.082 1.1	1.090 1.089 0.1	1.093 1.092 0.1	1.326 1.325 0.1	1.150 1.147 0.3	1.159 1.159 0.0	1.272 1.279 -0.7	0.589 0.604 -1.5	
11		0.357 0.354 0.3	1.121 1.114 0.7	1.358 1.350 0.8	1.146 1.137 0.9	1.150 1.144 0.6	1.123 1.120 0.3	1.343 1.353 -1.0	1.123 1.124 -0.1	1.150 1.151 -0.1	1.146 1.136 1.0	1.358 1.356 0.3	1.125 1.128 -0.3	0.364 0.367 -0.3	
12			0.467 0.463 0.4	1.182 1.175 0.6	1.358 1.351 0.7	1.159 1.154 0.5	1.365 1.361 0.3	0.953 0.951 0.3	1.366 1.364 0.2	1.159 1.156 0.3	1.358 1.352 0.6	1.182 1.178 0.3	0.467 0.466 0.1		
13				0.467 0.464 0.3	1.125 1.121 0.4	1.272 1.268 0.4	1.141 1.138 0.4	1.098 1.089 0.9	1.142 1.136 0.6	1.267 1.262 0.5	1.121 1.117 0.5	0.467 0.464 0.3			
14					0.364 0.362 0.2	0.589 0.588 0.1	1.056 1.059 -0.3	1.134 1.131 0.3	1.056 1.048 0.8	0.567 0.563 0.4	0.357 0.354 0.3				
15							0.330 0.344 -1.5	0.404 0.405 -0.2	0.329 0.328 0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-36: Plant A BOC 8 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.278 0.272 0.7	0.366 0.357 1.0	0.285 0.281 0.4						
2					0.296 0.285 1.1	0.501 0.488 1.4	1.069 1.047 2.2	1.136 1.119 1.8	1.071 1.060 1.1	0.502 0.501 0.1	0.295 0.292 0.3				
3				0.420 0.418 0.2	1.053 1.013 4.0	1.054 1.023 3.2	1.244 1.218 2.7	1.262 1.245 1.7	1.242 1.231 1.1	1.049 1.050 0.0	1.051 1.035 1.5	0.420 0.407 1.3			
4			0.419 0.392 2.6	1.113 1.063 5.0	1.154 1.088 6.6	1.281 1.242 3.9	1.238 1.204 3.3	1.276 1.208 6.8	1.229 1.213 1.6	1.276 1.305 -2.9	1.153 1.126 2.6	1.114 1.088 2.5	0.419 0.412 0.7		
5		0.294 0.276 1.8	1.046 0.962 8.4	1.138 1.092 4.6	1.306 1.282 2.4	1.237 1.218 1.9	1.290 1.289 0.1	1.267 1.250 1.7	1.278 1.265 1.3	1.233 1.212 2.1	1.307 1.212 9.4	1.139 1.115 2.4	1.047 1.036 1.1	0.294 0.296 -0.2	
6		0.500 0.488 1.1	1.045 1.013 3.2	1.270 1.240 3.0	1.231 1.200 3.1	1.319 1.308 1.1	1.205 1.209 -0.5	1.224 1.240 -1.6	1.198 1.201 -0.3	1.317 1.310 0.7	1.233 1.204 3.0	1.273 1.261 1.2	1.048 1.047 0.2	0.499 0.503 -0.4	
7	0.284 0.283 0.2	1.068 1.065 0.3	1.238 1.242 -0.3	1.226 1.219 0.7	1.276 1.271 0.5	1.198 1.200 -0.2	1.166 1.184 -1.8	1.100 1.115 -1.5	1.162 1.181 -1.9	1.201 1.192 0.9	1.286 1.277 0.8	1.232 1.240 -0.8	1.239 1.254 -1.5	1.064 1.087 -2.3	0.277 0.280 -0.3
8	0.366 0.361 0.4	1.134 1.136 -0.1	1.259 1.264 -0.5	1.273 1.281 -0.7	1.265 1.282 -1.7	1.222 1.229 -0.7	1.097 1.103 -0.6	0.876 0.883 -0.7	1.089 1.099 -0.9	1.219 1.182 3.7	1.263 1.260 0.2	1.271 1.285 -1.4	1.257 1.280 -2.3	1.132 1.088 4.4	0.365 0.357 0.7
9	0.278 0.278 0.0	1.067 1.072 -0.5	1.243 1.253 -1.0	1.236 1.246 -1.0	1.288 1.301 -1.3	1.202 1.202 0.0	1.158 1.150 0.8	1.086 1.099 -1.3	1.155 1.202 -4.7	1.194 1.226 -3.2	1.273 1.295 -2.2	1.224 1.250 -2.6	1.237 1.258 -2.2	1.067 1.068 -0.1	0.284 0.291 -0.8
10		0.500 0.505 -0.4	1.053 1.067 -1.4	1.279 1.293 -1.3	1.235 1.242 -0.7	1.316 1.306 1.0	1.195 1.142 5.3	1.218 1.224 -0.7	1.199 1.222 -2.3	1.315 1.336 -2.2	1.228 1.257 -2.9	1.268 1.318 -5.0	1.044 1.072 -2.8	0.499 0.516 -1.7	
11		0.295 0.299 -0.3	1.052 1.067 -1.5	1.153 1.167 -1.4	1.305 1.319 -1.4	1.229 1.236 -0.7	1.274 1.280 -0.7	1.263 1.304 -4.1	1.286 1.308 -2.1	1.234 1.228 0.6	1.304 1.334 -3.0	1.136 1.167 -3.1	1.045 1.065 -2.0	0.294 0.300 -0.7	
12			0.420 0.431 -1.1	1.112 1.129 -1.8	1.137 1.154 -1.7	1.269 1.290 -2.2	1.225 1.255 -3.0	1.272 1.309 -3.7	1.235 1.259 -2.4	1.279 1.300 -2.1	1.152 1.178 -2.6	1.112 1.140 -2.9	0.418 0.408 1.0		
13				0.418 0.425 -0.7	1.045 1.064 -1.9	1.045 1.066 -2.1	1.238 1.270 -3.3	1.258 1.308 -4.9	1.242 1.261 -1.9	1.052 1.085 -3.3	1.051 1.078 -2.7	0.420 0.430 -1.1			
14					0.294 0.302 -0.8	0.499 0.509 -1.0	1.068 1.087 -1.9	1.134 1.143 -1.0	1.066 1.032 3.4	0.500 0.501 -0.1	0.295 0.301 -0.5				
15							0.284 0.288 -0.4	0.365 0.367 -0.2	0.278 0.272 0.6						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 2.4

Figure A 10.4.1-37: Plant A MOC 8 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.297 0.296 0.1	0.392 0.392 0.0	0.304 0.305 -0.1						
2					0.289 0.286 0.3	0.503 0.499 0.4	1.105 1.099 0.6	1.209 1.211 -0.2	1.108 1.112 -0.4	0.504 0.508 -0.3	0.289 0.289 0.0				
3				0.397 0.405 -0.8	0.983 0.974 1.0	1.017 1.007 1.0	1.332 1.319 1.4	1.245 1.252 -0.8	1.331 1.338 -0.7	1.014 1.021 -0.8	0.982 0.979 0.3	0.397 0.388 0.9			
4			0.397 0.388 0.9	1.054 1.040 1.5	1.081 1.059 2.2	1.330 1.318 1.2	1.186 1.179 0.7	1.345 1.326 1.9	1.180 1.184 -0.4	1.327 1.351 -2.4	1.081 1.075 0.6	1.055 1.033 2.2	0.397 0.388 0.9		
5		0.288 0.281 0.7	0.980 0.950 3.0	1.071 1.054 1.7	1.379 1.362 1.7	1.186 1.183 0.2	1.197 1.210 -1.3	1.184 1.188 -0.4	1.188 1.194 -0.5	1.184 1.185 -0.2	1.380 1.354 2.6	1.072 1.035 3.7	0.981 0.956 2.6	0.289 0.282 0.7	
6		0.504 0.498 0.6	1.012 0.998 1.4	1.323 1.310 1.3	1.182 1.168 1.5	1.401 1.406 -0.5	1.172 1.190 -1.8	1.309 1.326 -1.7	1.168 1.180 -1.2	1.400 1.404 -0.3	1.184 1.173 1.1	1.326 1.301 2.5	1.015 0.996 1.8	0.503 0.494 0.9	
7	0.304 0.301 0.3	1.107 1.101 0.7	1.330 1.324 0.6	1.179 1.178 0.1	1.188 1.195 -0.7	1.168 1.186 -1.8	1.288 1.333 -4.5	1.121 1.146 -2.4	1.285 1.313 -2.8	1.170 1.180 -0.9	1.196 1.192 0.4	1.185 1.167 1.8	1.331 1.316 1.5	1.105 1.087 1.8	0.297 0.292 0.6
8	0.392 0.385 0.7	1.209 1.204 0.5	1.244 1.244 0.0	1.345 1.353 -0.9	1.184 1.209 -2.5	1.308 1.329 -2.1	1.119 1.140 -2.1	0.908 0.922 -1.4	1.114 1.130 -1.6	1.306 1.318 -1.2	1.183 1.189 -0.5	1.344 1.345 -0.1	1.244 1.246 -0.1	1.209 1.176 3.3	0.392 0.382 1.0
9	0.298 0.296 0.2	1.105 1.103 0.2	1.332 1.334 -0.2	1.186 1.192 -0.5	1.196 1.208 -1.1	1.171 1.181 -1.0	1.282 1.293 -1.0	1.111 1.121 -0.9	1.280 1.294 -1.4	1.166 1.187 -2.1	1.187 1.201 -1.4	1.179 1.192 -1.2	1.330 1.335 -0.5	1.108 1.098 1.0	0.304 0.297 0.7
10		0.503 0.503 0.0	1.017 1.017 0.0	1.330 1.333 -0.3	1.185 1.189 -0.4	1.399 1.402 -0.3	1.166 1.162 0.4	1.305 1.307 -0.2	1.169 1.173 -0.4	1.399 1.404 -0.5	1.182 1.197 -1.5	1.324 1.359 -3.6	1.012 1.025 -1.2	0.504 0.509 -0.5	
11		0.289 0.289 0.0	0.983 0.983 0.0	1.082 1.082 -0.1	1.379 1.378 0.1	1.182 1.182 0.0	1.187 1.186 0.1	1.183 1.181 0.3	1.196 1.191 0.5	1.185 1.165 2.0	1.379 1.391 -1.2	1.071 1.083 -1.2	0.981 0.986 -0.5	0.289 0.290 -0.2	
12			0.397 0.397 0.0	1.054 1.055 0.0	1.071 1.071 0.0	1.323 1.325 -0.1	1.179 1.181 -0.2	1.344 1.347 -0.2	1.186 1.185 0.1	1.330 1.325 0.5	1.082 1.084 -0.3	1.055 1.056 -0.1	0.397 0.385 1.2		
13				0.397 0.397 0.0	0.981 0.980 0.0	1.012 1.014 -0.1	1.330 1.335 -0.5	1.245 1.255 -1.1	1.333 1.333 -0.1	1.017 1.020 -0.3	0.983 0.986 -0.2	0.397 0.398 -0.1			
14					0.289 0.286 0.2	0.504 0.504 0.0	1.108 1.110 -0.2	1.209 1.210 0.0	1.106 1.097 0.9	0.503 0.503 0.1	0.289 0.290 -0.1				
15							0.304 0.306 -0.2	0.392 0.393 -0.1	0.298 0.297 0.1						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.2

Figure A 10.4.1-38: Plant A EOC 8 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.331 0.330 0.1	0.423 0.422 0.1	0.338 0.342 -0.3						
2					0.338 0.340 -0.3	0.555 0.556 0.0	1.085 1.084 0.1	1.147 1.162 -1.6	1.088 1.105 -1.7	0.557 0.565 -0.8	0.338 0.341 -0.3				
3				0.437 0.460 -2.3	0.997 1.011 -1.4	1.035 1.036 -0.1	1.369 1.351 1.9	1.203 1.239 -3.6	1.370 1.395 -2.5	1.034 1.053 -1.9	0.997 1.006 -0.8	0.437 0.433 0.4			
4			0.437 0.434 0.3	1.037 1.051 -1.4	1.053 1.064 -1.1	1.359 1.369 -0.9	1.161 1.158 0.3	1.358 1.329 3.0	1.158 1.167 -0.9	1.359 1.398 -3.9	1.054 1.058 -0.4	1.037 1.024 1.3	0.437 0.429 0.8		
5		0.338 0.332 0.6	0.998 0.974 2.4	1.047 1.053 -0.6	1.303 1.340 -3.7	1.121 1.139 -1.9	1.142 1.171 -2.9	1.144 1.150 -0.6	1.137 1.147 -0.9	1.120 1.131 -1.0	1.303 1.291 1.3	1.047 1.015 3.3	0.998 0.977 2.1	0.338 0.333 0.5	
6		0.557 0.555 0.2	1.034 1.029 0.5	1.359 1.361 -0.2	1.120 1.118 0.2	1.308 1.320 -1.1	1.134 1.147 -1.3	1.345 1.363 -1.8	1.132 1.144 -1.2	1.309 1.323 -1.4	1.121 1.115 0.6	1.360 1.341 1.8	1.036 1.021 1.5	0.556 0.544 1.2	
7	0.339 0.339 0.0	1.089 1.091 -0.3	1.371 1.376 -0.6	1.158 1.164 -0.6	1.138 1.146 -0.9	1.132 1.139 -0.7	1.349 1.354 -0.5	1.144 1.153 -0.9	1.349 1.364 -1.5	1.134 1.132 0.2	1.143 1.137 0.6	1.162 1.154 0.8	1.371 1.361 1.0	1.087 1.056 3.1	0.331 0.321 1.0
8	0.423 0.423 0.0	1.148 1.151 -0.3	1.204 1.209 -0.5	1.359 1.371 -1.2	1.145 1.168 -2.3	1.346 1.356 -1.0	1.143 1.145 -0.2	0.973 0.974 -0.1	1.140 1.142 -0.2	1.346 1.316 3.0	1.146 1.136 1.0	1.360 1.361 -0.1	1.205 1.223 -1.8	1.148 1.112 3.6	0.423 0.409 1.4
9	0.331 0.332 0.0	1.086 1.088 -0.3	1.370 1.374 -0.3	1.161 1.166 -0.4	1.143 1.146 -0.4	1.134 1.133 0.1	1.348 1.341 0.7	1.139 1.138 0.1	1.348 1.369 -2.2	1.132 1.131 0.1	1.139 1.135 0.4	1.159 1.158 0.1	1.371 1.375 -0.3	1.089 1.078 1.1	0.339 0.325 1.4
10		0.555 0.555 0.0	1.035 1.033 0.3	1.360 1.363 -0.3	1.121 1.122 0.0	1.309 1.301 0.8	1.132 1.107 2.5	1.346 1.324 2.2	1.134 1.127 0.7	1.310 1.300 1.0	1.121 1.118 0.3	1.360 1.357 0.3	1.035 1.037 -0.2	0.557 0.568 -1.1	
11		0.338 0.339 -0.1	0.997 1.005 -0.7	1.054 1.059 -0.5	1.303 1.310 -0.6	1.121 1.116 0.5	1.138 1.120 1.8	1.146 1.105 4.1	1.143 1.122 2.1	1.122 1.096 2.5	1.304 1.310 -0.6	1.048 1.047 0.1	0.998 0.998 0.1	0.338 0.340 -0.2	
12			0.437 0.452 -1.5	1.037 1.047 -1.0	1.047 1.050 -0.3	1.360 1.359 0.0	1.159 1.156 0.3	1.360 1.353 0.7	1.162 1.152 1.0	1.361 1.350 1.0	1.054 1.051 0.3	1.038 1.033 0.4	0.437 0.430 0.7		
13				0.437 0.439 -0.2	0.998 0.999 -0.1	1.035 1.036 -0.2	1.371 1.380 -0.9	1.204 1.232 -2.8	1.371 1.368 0.3	1.036 1.037 -0.2	0.998 0.997 0.0	0.437 0.436 0.1			
14					0.338 0.332 0.6	0.557 0.556 0.1	1.089 1.090 -0.1	1.148 1.146 0.1	1.086 1.056 3.0	0.555 0.549 0.7	0.338 0.336 0.2				
15							0.339 0.336 0.3	0.423 0.421 0.2	0.332 0.325 0.7						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.3

Figure A 10.4.1-39: Plant A BOC 9 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.297 0.297 0.1	0.376 0.377 -0.1	0.304 0.307 -0.3						
2					0.335 0.330 0.5	0.551 0.546 0.5	1.115 1.113 0.3	1.170 1.179 -0.9	1.111 1.124 -1.3	0.548 0.556 -0.8	0.334 0.338 -0.4				
3				0.432 0.434 -0.2	1.097 1.078 2.0	1.154 1.141 1.3	1.239 1.228 1.1	1.170 1.186 -1.6	1.224 1.243 -1.9	1.147 1.169 -2.2	1.091 1.103 -1.1	0.429 0.424 0.5			
4			0.430 0.417 1.2	1.153 1.131 2.1	1.189 1.151 3.8	1.235 1.223 1.2	1.245 1.238 0.7	0.906 0.890 1.6	1.238 1.254 -1.6	1.227 1.268 -4.1	1.185 1.198 -1.3	1.152 1.145 0.7	0.432 0.430 0.3		
5		0.335 0.324 1.0	1.093 1.051 4.2	1.186 1.176 1.0	1.262 1.296 -3.4	1.170 1.179 -0.9	1.201 1.214 -1.4	1.260 1.274 -1.4	1.202 1.220 -1.8	1.161 1.183 -2.2	1.262 1.268 -0.6	1.190 1.166 2.3	1.098 1.091 0.7	0.336 0.344 -0.8	
6		0.549 0.543 0.7	1.151 1.135 1.6	1.230 1.220 1.0	1.161 1.149 1.3	1.218 1.222 -0.4	1.180 1.195 -1.5	1.250 1.285 -3.5	1.180 1.202 -2.2	1.220 1.248 -2.8	1.171 1.178 -0.7	1.235 1.230 0.6	1.156 1.154 0.2	0.552 0.556 -0.4	
7	0.305 0.303 0.3	1.114 1.110 0.4	1.230 1.234 -0.4	1.245 1.240 0.5	1.201 1.195 0.6	1.175 1.177 -0.2	1.266 1.279 -1.3	1.162 1.178 -1.7	1.275 1.289 -1.4	1.183 1.189 -0.6	1.201 1.202 -0.1	1.246 1.242 0.5	1.240 1.243 -0.3	1.116 1.130 -1.4	0.297 0.298 -0.1
8	0.376 0.369 0.7	1.172 1.165 0.7	1.173 1.169 0.4	0.905 0.902 0.4	1.253 1.246 0.7	1.242 1.240 0.1	1.148 1.149 -0.1	0.956 0.963 -0.6	1.166 1.176 -0.9	1.251 1.235 1.6	1.261 1.258 0.3	0.907 0.906 0.1	1.171 1.171 -0.1	1.171 1.134 3.7	0.376 0.370 0.6
9	0.298 0.294 0.3	1.115 1.107 0.9	1.236 1.228 0.8	1.237 1.235 0.3	1.193 1.201 -0.8	1.174 1.169 0.5	1.260 1.249 1.0	1.152 1.157 -0.5	1.270 1.307 -3.7	1.179 1.178 0.1	1.202 1.205 -0.3	1.239 1.247 -0.8	1.225 1.230 -0.5	1.112 1.105 0.7	0.305 0.314 -0.9
10		0.550 0.544 0.6	1.152 1.134 1.8	1.230 1.225 0.5	1.166 1.165 0.1	1.213 1.199 1.4	1.172 1.129 4.3	1.243 1.233 1.0	1.179 1.182 -0.4	1.219 1.217 0.2	1.162 1.172 -1.0	1.228 1.252 -2.4	1.149 1.159 -1.0	0.548 0.552 -0.3	
11		0.335 0.332 0.3	1.095 1.088 0.7	1.186 1.185 0.1	1.258 1.267 -0.9	1.156 1.150 0.6	1.194 1.177 1.6	1.251 1.244 0.7	1.200 1.191 0.8	1.172 1.150 2.2	1.263 1.282 -1.9	1.186 1.205 -1.9	1.093 1.098 -0.6	0.334 0.336 -0.1	
12			0.429 0.431 -0.2	1.150 1.150 -0.1	1.183 1.184 -0.2	1.224 1.221 0.3	1.233 1.224 0.9	0.906 0.903 0.3	1.251 1.244 0.7	1.238 1.230 0.8	1.191 1.201 -1.0	1.154 1.182 -2.8	0.430 0.416 1.4		
13				0.430 0.431 0.0	1.090 1.091 -0.1	1.147 1.146 0.1	1.226 1.225 0.1	1.178 1.183 -0.6	1.246 1.240 0.6	1.158 1.146 1.2	1.099 1.101 -0.2	0.433 0.438 -0.5			
14					0.334 0.338 -0.4	0.548 0.548 0.0	1.114 1.110 0.3	1.175 1.171 0.4	1.120 1.110 1.1	0.553 0.548 0.5	0.336 0.336 0.1				
15							0.305 0.302 0.4	0.377 0.375 0.2	0.298 0.296 0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.3

Figure A 10.4.1-40: Plant A MOC 9 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.311 0.312 0.0	0.396 0.393 0.3	0.318 0.319 0.0						
2					0.327 0.326 0.1	0.541 0.542 -0.1	1.128 1.132 -0.4	1.245 1.242 0.3	1.126 1.128 -0.2	0.539 0.546 -0.7	0.326 0.331 -0.5				
3				0.409 0.420 -1.0	1.047 1.044 0.4	1.105 1.105 -0.1	1.312 1.325 -1.3	1.124 1.114 1.0	1.299 1.301 -0.1	1.100 1.115 -1.5	1.044 1.056 -1.2	0.407 0.408 -0.1			
4			0.407 0.399 0.8	1.084 1.074 1.0	1.123 1.103 2.0	1.372 1.364 0.8	1.172 1.162 1.0	0.862 0.818 4.3	1.166 1.165 0.1	1.365 1.402 -3.6	1.120 1.135 -1.5	1.084 1.087 -0.3	0.409 0.408 0.1		
5		0.326 0.318 0.9	1.045 1.010 3.4	1.121 1.113 0.8	1.364 1.383 -1.9	1.156 1.159 -0.3	1.116 1.115 0.2	1.154 1.145 0.9	1.117 1.119 -0.2	1.148 1.161 -1.3	1.364 1.377 -1.3	1.123 1.117 0.6	1.048 1.038 0.9	0.327 0.315 1.2	
6		0.540 0.533 0.7	1.102 1.087 1.6	1.368 1.357 1.0	1.149 1.143 0.6	1.386 1.389 -0.3	1.160 1.169 -0.9	1.392 1.400 -0.8	1.159 1.165 -0.6	1.387 1.393 -0.6	1.156 1.159 -0.3	1.372 1.365 0.7	1.105 1.098 0.7	0.542 0.538 0.4	
7	0.319 0.315 0.4	1.128 1.118 1.0	1.304 1.296 0.9	1.171 1.167 0.4	1.116 1.118 -0.2	1.157 1.166 -0.9	1.350 1.378 -2.8	1.140 1.152 -1.2	1.356 1.366 -1.0	1.161 1.162 -0.1	1.116 1.114 0.2	1.172 1.162 1.0	1.312 1.303 0.9	1.128 1.129 -0.1	0.311 0.310 0.1
8	0.396 0.387 0.9	1.246 1.236 1.0	1.127 1.121 0.6	0.862 0.860 0.2	1.150 1.157 -0.6	1.387 1.388 -0.2	1.131 1.136 -0.5	0.943 0.947 -0.4	1.142 1.146 -0.3	1.393 1.382 1.1	1.154 1.150 0.4	0.862 0.859 0.3	1.124 1.111 1.3	1.245 1.189 5.6	0.396 0.388 0.8
9	0.312 0.309 0.3	1.129 1.123 0.6	1.311 1.307 0.4	1.168 1.164 0.4	1.113 1.095 1.8	1.158 1.148 0.9	1.346 1.330 1.6	1.133 1.131 0.2	1.353 1.363 -1.0	1.158 1.143 1.6	1.116 1.117 -0.1	1.166 1.175 -0.8	1.300 1.297 0.3	1.126 1.116 1.0	0.319 0.340 -2.1
10		0.541 0.541 0.0	1.104 1.105 -0.1	1.370 1.378 -0.8	1.156 1.164 -0.8	1.384 1.371 1.3	1.155 1.115 4.0	1.387 1.375 1.2	1.160 1.155 0.4	1.387 1.372 1.4	1.148 1.161 -1.2	1.366 1.401 -3.5	1.101 1.112 -1.1	0.539 0.545 -0.6	
11		0.327 0.329 -0.2	1.048 1.059 -1.1	1.123 1.145 -2.3	1.363 1.421 -5.8	1.147 1.156 -0.9	1.113 1.102 1.0	1.149 1.161 -1.2	1.116 1.110 0.6	1.157 1.125 3.2	1.364 1.393 -2.8	1.121 1.138 -1.7	1.044 1.048 -0.4	0.326 0.328 -0.2	
12			0.408 0.414 -0.7	1.084 1.102 -1.9	1.120 1.140 -2.0	1.365 1.364 0.0	1.164 1.138 2.6	0.862 0.861 0.1	1.175 1.174 0.1	1.374 1.368 0.6	1.123 1.132 -0.8	1.084 1.088 -0.4	0.407 0.389 1.8		
13				0.409 0.414 -0.5	1.044 1.051 -0.7	1.101 1.101 0.0	1.301 1.297 0.5	1.129 1.139 -1.0	1.317 1.323 -0.7	1.106 1.115 -0.8	1.048 1.056 -0.8	0.409 0.412 -0.3			
14					0.326 0.320 0.6	0.540 0.539 0.1	1.127 1.128 -0.1	1.247 1.254 -0.7	1.130 1.141 -1.1	0.542 0.548 -0.6	0.327 0.331 -0.4				
15							0.319 0.321 -0.2	0.396 0.399 -0.3	0.312 0.315 -0.3						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.3

Figure A 10.4.1-41: Plant A EOC 9 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.352 0.348 0.4	0.438 0.439 -0.1	0.360 0.360 -0.1						
2					0.367 0.365 0.2	0.591 0.583 0.8	1.143 1.124 1.8	1.243 1.234 0.9	1.144 1.146 -0.2	0.591 0.604 -1.4	0.367 0.371 -0.3				
3				0.441 0.457 -1.6	1.043 1.042 0.1	1.109 1.097 1.3	1.397 1.359 3.7	1.150 1.138 1.2	1.393 1.393 -0.1	1.109 1.117 -0.8	1.041 1.041 0.0	0.439 0.428 1.1			
4			0.439 0.436 0.4	1.070 1.075 -0.4	1.101 1.096 0.4	1.336 1.333 0.4	1.163 1.155 0.8	0.907 0.899 0.8	1.161 1.165 -0.4	1.335 1.352 -1.7	1.100 1.100 0.0	1.071 1.058 1.2	0.441 0.436 0.5		
5		0.367 0.362 0.5	1.041 1.021 2.0	1.100 1.103 -0.3	1.401 1.432 -3.0	1.118 1.130 -1.2	1.075 1.093 -1.8	1.110 1.117 -0.7	1.076 1.083 -0.6	1.112 1.117 -0.4	1.401 1.395 0.6	1.101 1.081 1.9	1.043 1.032 1.0	0.368 0.369 -0.1	
6		0.591 0.588 0.3	1.109 1.102 0.7	1.335 1.335 0.1	1.113 1.111 0.1	1.319 1.328 -0.9	1.099 1.109 -1.1	1.310 1.323 -1.3	1.097 1.108 -1.1	1.318 1.321 -0.2	1.118 1.114 0.4	1.336 1.328 0.8	1.110 1.102 0.8	0.591 0.585 0.6	
7	0.360 0.362 -0.2	1.143 1.144 -0.1	1.393 1.389 0.4	1.164 1.166 -0.2	1.077 1.084 -0.7	1.097 1.105 -0.8	1.315 1.326 -1.1	1.091 1.104 -1.3	1.317 1.347 -3.0	1.098 1.094 0.5	1.075 1.070 0.5	1.162 1.166 -0.4	1.397 1.391 0.6	1.142 1.124 1.8	0.351 0.345 0.6
8	0.438 0.448 -1.0	1.243 1.249 -0.7	1.151 1.154 -0.3	0.907 0.913 -0.6	1.109 1.129 -2.0	1.310 1.322 -1.1	1.087 1.091 -0.4	0.944 0.947 -0.3	1.093 1.093 0.0	1.310 1.263 4.7	1.109 1.095 1.4	0.907 0.903 0.3	1.150 1.152 -0.3	1.242 1.203 3.9	0.438 0.429 1.0
9	0.352 0.356 -0.3	1.143 1.149 -0.6	1.397 1.403 -0.7	1.161 1.171 -1.0	1.075 1.093 -1.8	1.099 1.103 -0.4	1.315 1.309 0.6	1.088 1.089 0.0	1.316 1.331 -1.5	1.097 1.106 -0.9	1.076 1.073 0.2	1.161 1.159 0.2	1.392 1.390 0.3	1.144 1.133 1.1	0.360 0.364 -0.4
10		0.591 0.593 -0.2	1.110 1.111 -0.1	1.337 1.348 -1.0	1.119 1.130 -1.0	1.320 1.316 0.4	1.098 1.068 3.0	1.310 1.299 1.1	1.098 1.099 0.0	1.318 1.318 0.0	1.112 1.111 0.2	1.335 1.335 0.1	1.109 1.109 0.0	0.591 0.594 -0.3	
11		0.368 0.371 -0.3	1.044 1.055 -1.2	1.102 1.115 -1.4	1.403 1.427 -2.4	1.113 1.115 -0.2	1.075 1.064 1.1	1.107 1.100 0.7	1.075 1.071 0.4	1.118 1.110 0.7	1.401 1.397 0.4	1.100 1.105 -0.5	1.041 1.042 -0.1	0.368 0.368 -0.1	
12			0.440 0.456 -1.6	1.071 1.085 -1.4	1.101 1.108 -0.8	1.336 1.334 0.2	1.160 1.148 1.2	0.907 0.905 0.2	1.164 1.162 0.1	1.336 1.338 -0.2	1.100 1.107 -0.7	1.070 1.096 -2.6	0.439 0.436 0.3		
13				0.441 0.444 -0.2	1.042 1.039 0.3	1.109 1.107 0.3	1.393 1.391 0.1	1.152 1.166 -1.5	1.397 1.394 0.3	1.108 1.116 -0.8	1.042 1.050 -0.8	0.441 0.448 -0.7			
14					0.368 0.353 1.5	0.591 0.586 0.5	1.143 1.139 0.4	1.242 1.234 0.8	1.141 1.112 3.0	0.590 0.586 0.5	0.367 0.368 -0.1				
15							0.359 0.361 -0.1	0.438 0.435 0.3	0.351 0.344 0.7						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.1

Figure A 10.4.1-42: Plant A BOC 10 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.311 0.308 0.2	0.397 0.386 1.1	0.312 0.312 0.1						
2					0.285 0.283 0.2	0.579 0.577 0.2	1.152 1.151 0.1	1.096 1.105 -0.9	1.151 1.159 -0.8	0.579 0.579 0.0	0.285 0.286 -0.1	Calculated Power Measured Power Difference (C-M)*100			
3				0.422 0.421 0.2	0.848 0.841 0.7	1.227 1.221 0.6	1.296 1.293 0.3	0.880 0.913 -3.3	1.291 1.307 -1.6	1.226 1.234 -0.8	0.850 0.855 -0.5	0.423 0.427 -0.4			
4			0.423 0.418 0.5	1.167 1.154 1.4	1.287 1.273 1.4	1.357 1.348 0.9	1.208 1.205 0.3	1.264 1.264 0.1	1.199 1.206 -0.7	1.355 1.361 -0.5	1.288 1.292 -0.5	1.167 1.169 -0.1	0.422 0.422 0.0		
5		0.285 0.280 0.4	0.849 0.837 1.2	1.287 1.271 1.6	1.225 1.211 1.4	1.262 1.256 0.7	1.264 1.265 0.0	1.180 1.182 -0.1	1.258 1.267 -0.8	1.260 1.267 -0.6	1.225 1.229 -0.4	1.287 1.285 0.2	0.848 0.846 0.1	0.285 0.286 -0.2	
6		0.579 0.568 1.1	1.224 1.202 2.2	1.354 1.336 1.8	1.260 1.253 0.6	0.878 0.872 0.7	1.254 1.248 0.6	1.153 1.152 0.1	1.247 1.264 -1.7	0.879 0.883 -0.4	1.263 1.267 -0.4	1.357 1.356 0.1	1.227 1.223 0.4	0.579 0.575 0.4	
7	0.312 0.307 0.5	1.151 1.128 2.3	1.290 1.255 3.4	1.198 1.178 2.1	1.257 1.241 1.6	1.247 1.234 1.3	1.211 1.195 1.6	1.125 1.136 -1.1	1.212 1.261 -4.9	1.255 1.273 -1.8	1.265 1.272 -0.7	1.209 1.208 0.1	1.297 1.289 0.8	1.152 1.137 1.6	0.311 0.308 0.3
8	0.397 0.394 0.3	1.095 1.080 1.5	0.879 0.864 1.5	1.263 1.244 1.9	1.179 1.156 2.3	1.152 1.141 1.1	1.125 1.121 0.3	0.797 0.804 -0.8	1.126 1.152 -2.6	1.155 1.158 -0.3	1.181 1.186 -0.4	1.265 1.264 0.1	0.880 0.872 0.9	1.096 1.101 -0.5	0.397 0.397 0.0
9	0.311 0.308 0.2	1.151 1.142 0.9	1.295 1.289 0.6	1.206 1.194 1.2	1.263 1.247 1.6	1.254 1.247 0.7	1.211 1.215 -0.4	1.125 1.141 -1.6	1.211 1.250 -3.8	1.248 1.258 -1.0	1.259 1.269 -1.0	1.201 1.202 -0.2	1.292 1.292 -0.1	1.152 1.155 -0.3	0.312 0.310 0.2
10		0.579 0.579 0.0	1.226 1.236 -1.0	1.356 1.348 0.7	1.261 1.249 1.2	0.878 0.874 0.4	1.248 1.260 -1.3	1.154 1.161 -0.7	1.255 1.272 -1.7	0.879 0.889 -1.0	1.261 1.281 -2.1	1.356 1.354 0.2	1.226 1.231 -0.5	0.579 0.588 -0.8	
11		0.284 0.284 0.0	0.848 0.846 0.2	1.287 1.275 1.1	1.224 1.203 2.1	1.260 1.248 1.1	1.258 1.251 0.7	1.181 1.165 1.6	1.264 1.270 -0.6	1.262 1.278 -1.6	1.225 1.280 -5.5	1.288 1.307 -1.9	0.850 0.859 -0.9	0.285 0.289 -0.4	
12			0.422 0.419 0.3	1.167 1.156 1.2	1.287 1.273 1.4	1.355 1.341 1.4	1.199 1.182 1.7	1.264 1.257 0.7	1.207 1.211 -0.4	1.356 1.369 -1.4	1.287 1.310 -2.4	1.168 1.172 -0.4	0.424 0.429 -0.6		
13				0.423 0.420 0.3	0.850 0.845 0.4	1.225 1.220 0.5	1.291 1.288 0.2	0.880 0.886 -0.6	1.295 1.303 -0.8	1.225 1.234 -0.8	0.847 0.856 -0.9	0.423 0.425 -0.3			
14					0.285 0.292 -0.7	0.579 0.581 -0.2	1.151 1.157 -0.6	1.096 1.103 -0.7	1.151 1.157 -0.6	0.578 0.582 -0.3	0.284 0.287 -0.2				
15							0.312 0.325 -1.2	0.398 0.402 -0.5	0.311 0.313 -0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.2

Figure A 10.4.1-43: Plant A MOC 10 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.316 0.316 0.0	0.410 0.409 0.1	0.318 0.317 0.1						
2					0.292 0.292 0.0	0.581 0.580 0.0	1.124 1.123 0.1	1.176 1.175 0.1	1.124 1.121 0.3	0.582 0.576 0.5	0.292 0.291 0.2				
3				0.412 0.418 -0.6	0.826 0.825 0.1	1.303 1.304 -0.1	1.379 1.379 0.0	0.897 0.898 -0.1	1.375 1.373 0.2	1.303 1.299 0.4	0.828 0.825 0.3	0.412 0.414 -0.1			
4			0.413 0.412 0.1	1.104 1.104 0.0	1.358 1.350 0.8	1.284 1.285 -0.1	1.124 1.125 -0.1	1.135 1.125 1.0	1.118 1.116 0.2	1.283 1.280 0.3	1.358 1.350 0.8	1.103 1.087 1.7	0.412 0.405 0.7		
5		0.292 0.291 0.2	0.827 0.824 0.3	1.358 1.361 -0.3	1.195 1.215 -2.0	1.400 1.411 -1.1	1.339 1.355 -1.6	1.065 1.071 -0.6	1.334 1.339 -0.5	1.398 1.402 -0.4	1.195 1.191 0.4	1.358 1.318 4.0	0.826 0.811 1.5	0.292 0.295 -0.3	
6		0.581 0.577 0.4	1.303 1.294 0.9	1.283 1.274 0.9	1.398 1.375 2.3	0.902 0.901 0.1	1.140 1.149 -0.9	1.042 1.058 -1.6	1.135 1.143 -0.9	0.902 0.918 -1.6	1.400 1.398 0.1	1.283 1.267 1.6	1.303 1.287 1.6	0.581 0.574 0.7	
7	0.317 0.316 0.2	1.124 1.116 0.8	1.375 1.363 1.2	1.118 1.111 0.7	1.334 1.325 0.9	1.135 1.134 0.1	1.122 1.126 -0.3	1.248 1.256 -0.8	1.123 1.119 0.3	1.140 1.145 -0.5	1.339 1.338 0.1	1.124 1.116 0.8	1.379 1.366 1.3	1.124 1.104 2.0	0.316 0.311 0.6
8	0.410 0.411 -0.1	1.176 1.170 0.6	0.897 0.891 0.5	1.135 1.132 0.3	1.065 1.063 0.2	1.041 1.045 -0.4	1.247 1.256 -0.8	0.877 0.886 -0.9	1.248 1.266 -1.8	1.043 1.051 -0.8	1.066 1.066 -0.1	1.136 1.133 0.2	0.897 0.898 -0.1	1.176 1.158 1.8	0.410 0.403 0.6
9	0.316 0.315 0.1	1.124 1.118 0.6	1.379 1.372 0.6	1.123 1.126 -0.3	1.338 1.361 -2.3	1.140 1.150 -1.1	1.122 1.132 -1.0	1.248 1.269 -2.1	1.122 1.169 -4.6	1.135 1.145 -0.9	1.335 1.334 0.0	1.119 1.116 0.3	1.375 1.372 0.3	1.124 1.117 0.7	0.317 0.311 0.6
10		0.581 0.577 0.4	1.303 1.290 1.3	1.283 1.285 -0.2	1.399 1.410 -1.1	0.902 0.906 -0.5	1.135 1.138 -0.3	1.043 1.046 -0.3	1.140 1.154 -1.4	0.902 0.905 -0.3	1.398 1.389 0.9	1.283 1.277 0.6	1.303 1.302 0.1	0.581 0.587 -0.5	
11		0.292 0.291 0.1	0.826 0.827 -0.1	1.358 1.363 -0.5	1.194 1.201 -0.7	1.398 1.402 -0.4	1.334 1.331 0.3	1.066 1.043 2.3	1.339 1.339 0.0	1.400 1.409 -1.0	1.195 1.165 3.0	1.359 1.351 0.8	0.828 0.827 0.1	0.292 0.293 -0.1	
12			0.412 0.424 -1.2	1.104 1.112 -0.8	1.359 1.366 -0.7	1.283 1.288 -0.5	1.119 1.121 -0.3	1.135 1.130 0.5	1.123 1.122 0.1	1.283 1.282 0.1	1.358 1.351 0.7	1.104 1.115 -1.1	0.413 0.418 -0.5		
13				0.413 0.415 -0.2	0.828 0.831 -0.3	1.303 1.309 -0.6	1.375 1.382 -0.7	0.897 0.898 -0.2	1.378 1.380 -0.1	1.303 1.297 0.6	0.825 0.822 0.3	0.412 0.414 -0.2			
14					0.292 0.290 0.2	0.581 0.584 -0.3	1.124 1.134 -1.0	1.176 1.185 -0.9	1.124 1.133 -0.9	0.581 0.581 0.0	0.292 0.291 0.1				
15							0.318 0.329 -1.2	0.410 0.415 -0.5	0.316 0.319 -0.3						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure A 10.4.1-44: Plant A EOC 10 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.367 0.366 0.1	0.472 0.465 0.7	0.369 0.368 0.1						
2					0.336 0.339 -0.3	0.624 0.627 -0.3	1.132 1.135 -0.3	1.217 1.220 -0.3	1.133 1.136 -0.3	0.625 0.627 -0.2	0.337 0.337 -0.1				
3				0.441 0.449 -0.8	0.826 0.836 -0.9	1.263 1.272 -0.9	1.372 1.375 -0.3	0.955 0.965 -1.0	1.371 1.375 -0.4	1.264 1.264 0.0	0.829 0.829 0.0	0.442 0.446 -0.4			
4			0.442 0.448 -0.5	1.040 1.054 -1.4	1.248 1.266 -1.8	1.203 1.216 -1.2	1.101 1.108 -0.7	1.132 1.129 0.2	1.098 1.099 0.0	1.204 1.198 0.6	1.249 1.245 0.4	1.040 1.028 1.2	0.441 0.435 0.6		
5		0.337 0.338 -0.1	0.828 0.838 -1.0	1.249 1.263 -1.4	1.119 1.140 -2.1	1.350 1.368 -1.8	1.325 1.346 -2.1	1.068 1.077 -0.9	1.324 1.331 -0.7	1.350 1.358 -0.8	1.119 1.122 -0.3	1.248 1.216 3.2	0.826 0.811 1.5	0.336 0.331 0.5	
6		0.625 0.622 0.3	1.264 1.260 0.4	1.204 1.204 0.0	1.350 1.348 0.2	0.947 0.952 -0.5	1.150 1.161 -1.1	1.068 1.085 -1.7	1.147 1.154 -0.7	0.947 0.970 -2.2	1.350 1.355 -0.5	1.203 1.192 1.1	1.263 1.248 1.4	0.624 0.613 1.1	
7	0.369 0.367 0.1	1.134 1.124 1.0	1.371 1.349 2.2	1.098 1.093 0.5	1.324 1.325 -0.1	1.147 1.150 -0.3	1.160 1.161 -0.1	1.343 1.343 0.0	1.160 1.141 1.9	1.150 1.153 -0.3	1.325 1.327 -0.2	1.101 1.097 0.3	1.371 1.361 1.0	1.132 1.104 2.8	0.367 0.360 0.7
8	0.472 0.477 -0.4	1.217 1.211 0.6	0.955 0.947 0.8	1.132 1.130 0.2	1.067 1.074 -0.6	1.068 1.071 -0.3	1.343 1.346 -0.3	0.997 0.997 0.0	1.343 1.343 0.0	1.069 1.075 -0.6	1.068 1.068 -0.1	1.131 1.133 -0.1	0.955 0.965 -1.0	1.216 1.217 -0.1	0.472 0.468 0.4
9	0.367 0.367 0.0	1.132 1.128 0.5	1.372 1.365 0.7	1.100 1.099 0.1	1.325 1.330 -0.4	1.150 1.153 -0.3	1.160 1.163 -0.3	1.343 1.347 -0.4	1.160 1.171 -1.1	1.147 1.142 0.5	1.324 1.319 0.5	1.099 1.095 0.4	1.370 1.371 -0.1	1.133 1.131 0.2	0.369 0.358 1.0
10		0.624 0.621 0.3	1.263 1.254 0.9	1.203 1.203 0.0	1.350 1.355 -0.5	0.947 0.949 -0.2	1.147 1.151 -0.4	1.068 1.066 0.3	1.150 1.150 0.0	0.947 0.944 0.4	1.350 1.338 1.1	1.204 1.192 1.2	1.264 1.260 0.3	0.625 0.627 -0.2	
11		0.336 0.336 0.1	0.827 0.827 0.0	1.248 1.253 -0.4	1.119 1.128 -0.9	1.350 1.353 -0.3	1.324 1.320 0.4	1.068 1.049 1.9	1.325 1.320 0.5	1.350 1.353 -0.3	1.119 1.099 2.0	1.249 1.236 1.3	0.829 0.825 0.3	0.337 0.337 0.0	
12			0.441 0.448 -0.6	1.040 1.046 -0.5	1.249 1.254 -0.5	1.204 1.206 -0.2	1.098 1.096 0.2	1.132 1.125 0.7	1.100 1.097 0.3	1.203 1.201 0.2	1.248 1.239 1.0	1.040 1.032 0.8	0.442 0.447 -0.4		
13				0.442 0.444 -0.1	0.829 0.829 0.0	1.264 1.265 -0.1	1.371 1.372 -0.1	0.955 0.953 0.2	1.372 1.372 0.0	1.263 1.266 -0.3	0.826 0.823 0.3	0.442 0.439 0.3			
14					0.337 0.331 0.6	0.625 0.625 0.0	1.133 1.138 -0.5	1.217 1.220 -0.3	1.132 1.132 0.0	0.624 0.624 0.0	0.336 0.335 0.1				
15							0.369 0.380 -1.1	0.473 0.476 -0.3	0.367 0.368 -0.1						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-45: Plant A BOC 11 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.327 0.319 0.8	0.382 0.359 2.4	0.330 0.322 0.8						
2					0.392 0.389 0.4	0.939 0.930 0.9	1.163 1.149 1.5	1.075 1.058 1.8	1.169 1.154 1.5	0.942 0.933 0.9	0.393 0.391 0.2				
3				0.457 0.452 0.5	1.098 1.087 1.1	1.173 1.166 0.7	1.194 1.186 0.8	1.169 1.156 1.2	1.199 1.190 0.9	1.174 1.168 0.7	1.098 1.096 0.3	0.458 0.463 -0.5			
4			0.458 0.457 0.1	1.163 1.157 0.6	1.168 1.154 1.4	1.063 1.062 0.1	1.095 1.098 -0.4	1.229 1.243 -1.5	1.093 1.095 -0.2	1.058 1.050 0.8	1.166 1.164 0.2	1.163 1.163 0.0	0.457 0.458 0.0		
5		0.393 0.391 0.2	1.098 1.098 0.1	1.166 1.172 -0.6	1.038 1.070 -3.2	1.143 1.156 -1.3	1.277 1.288 -1.1	1.188 1.204 -1.6	1.263 1.274 -1.1	1.118 1.119 -0.1	1.038 1.038 0.0	1.168 1.168 0.0	1.099 1.098 0.0	0.393 0.395 -0.3	
6		0.942 0.930 1.1	1.174 1.164 1.1	1.057 1.053 0.5	1.117 1.115 0.2	1.073 1.082 -0.9	1.140 1.161 -2.0	1.127 1.157 -3.0	1.127 1.147 -2.0	1.073 1.074 -0.1	1.143 1.144 0.0	1.063 1.060 0.3	1.174 1.172 0.1	0.939 0.939 0.0	
7	0.330 0.325 0.5	1.169 1.151 1.8	1.199 1.174 2.5	1.093 1.079 1.3	1.263 1.252 1.1	1.127 1.135 -0.8	1.212 1.245 -3.4	1.067 1.101 -3.3	1.211 1.253 -4.1	1.140 1.157 -1.6	1.277 1.281 -0.3	1.094 1.085 1.0	1.194 1.188 0.5	1.163 1.163 0.0	0.327 0.327 0.0
8	0.382 0.378 0.4	1.075 1.062 1.3	1.169 1.153 1.6	1.229 1.212 1.7	1.188 1.156 3.2	1.127 1.129 -0.2	1.067 1.091 -2.3	1.235 1.281 -4.5	1.067 1.120 -5.2	1.127 1.149 -2.2	1.188 1.192 -0.4	1.228 1.224 0.5	1.168 1.160 0.8	1.075 1.060 1.5	0.382 0.379 0.3
9	0.327 0.325 0.3	1.163 1.153 1.0	1.194 1.186 0.8	1.095 1.091 0.4	1.277 1.288 -1.0	1.141 1.149 -0.9	1.212 1.235 -2.4	1.067 1.114 -4.7	1.212 1.338 -12.6	1.127 1.128 -0.1	1.263 1.261 0.2	1.092 1.086 0.7	1.199 1.191 0.8	1.169 1.161 0.8	0.330 0.331 -0.1
10		0.939 0.935 0.4	1.174 1.172 0.1	1.063 1.061 0.2	1.144 1.143 0.1	1.073 1.074 0.0	1.127 1.133 -0.6	1.127 1.141 -1.3	1.140 1.174 -3.4	1.073 1.077 -0.4	1.117 1.111 0.7	1.057 1.043 1.4	1.174 1.167 0.7	0.941 0.941 0.0	
11		0.393 0.393 -0.1	1.099 1.105 -0.6	1.168 1.168 0.0	1.038 1.026 1.2	1.118 1.107 1.1	1.263 1.246 1.7	1.188 1.157 3.2	1.277 1.273 0.4	1.143 1.133 1.1	1.038 1.024 1.4	1.166 1.163 0.3	1.098 1.095 0.3	0.393 0.393 0.0	
12			0.457 0.478 -2.1	1.163 1.167 -0.3	1.166 1.159 0.7	1.058 1.044 1.4	1.093 1.065 2.7	1.229 1.208 2.1	1.095 1.085 0.9	1.063 1.056 0.7	1.168 1.167 0.0	1.163 1.181 -1.8	0.458 0.460 -0.2		
13				0.458 0.457 0.1	1.099 1.089 0.9	1.174 1.162 1.2	1.199 1.182 1.7	1.169 1.156 1.3	1.194 1.186 0.7	1.174 1.165 0.9	1.099 1.095 0.3	0.457 0.460 -0.3			
14					0.393 0.390 0.3	0.942 0.932 1.0	1.169 1.159 1.0	1.075 1.070 0.5	1.163 1.166 -0.3	0.939 0.937 0.3	0.392 0.392 0.1				
15							0.330 0.333 -0.2	0.382 0.382 0.0	0.327 0.328 -0.1						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.7

Figure A 10.4.1-46: Plant A MOC 11 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.355 0.351 0.4	0.424 0.419 0.5	0.357 0.355 0.3						
2					0.421 0.416 0.5	0.987 0.977 1.0	1.189 1.177 1.2	1.203 1.193 1.0	1.193 1.187 0.6	0.988 0.986 0.3	0.422 0.421 0.1				
3				0.476 0.475 0.2	1.163 1.149 1.4	1.274 1.260 1.3	1.126 1.112 1.4	1.106 1.094 1.2	1.130 1.126 0.4	1.274 1.273 0.2	1.163 1.165 -0.2	0.477 0.483 -0.5			
4			0.477 0.470 0.7	1.163 1.147 1.6	1.271 1.248 2.2	1.020 1.011 0.9	1.027 1.028 -0.1	1.277 1.294 -1.6	1.026 1.030 -0.4	1.017 1.014 0.3	1.269 1.272 -0.2	1.163 1.167 -0.4	0.477 0.478 -0.1		
5		0.422 0.416 0.6	1.163 1.145 1.8	1.269 1.252 1.7	0.986 0.968 1.8	1.036 1.034 0.2	1.282 1.295 -1.3	1.100 1.111 -1.1	1.270 1.281 -1.1	1.016 1.019 -0.3	0.986 0.988 -0.2	1.271 1.275 -0.4	1.163 1.166 -0.3	0.421 0.419 0.2	
6		0.988 0.980 0.9	1.274 1.262 1.2	1.017 1.009 0.8	1.015 1.017 -0.1	0.961 0.966 -0.6	1.045 1.061 -1.6	1.032 1.045 -1.3	1.036 1.050 -1.4	0.961 0.964 -0.3	1.036 1.039 -0.3	1.020 1.022 -0.2	1.274 1.280 -0.6	0.987 0.995 -0.8	
7	0.357 0.355 0.2	1.193 1.185 0.8	1.130 1.122 0.8	1.026 1.020 0.6	1.270 1.268 0.2	1.036 1.046 -1.0	1.303 1.341 -3.8	1.047 1.071 -2.4	1.302 1.341 -3.8	1.045 1.057 -1.2	1.282 1.288 -0.6	1.027 1.025 0.2	1.126 1.131 -0.5	1.189 1.208 -1.9	0.355 0.359 -0.4
8	0.424 0.422 0.2	1.203 1.197 0.6	1.106 1.100 0.7	1.278 1.269 0.8	1.100 1.085 1.5	1.032 1.036 -0.4	1.047 1.064 -1.7	1.349 1.374 -2.6	1.047 1.069 -2.2	1.032 1.040 -0.8	1.099 1.103 -0.4	1.277 1.278 0.0	1.106 1.104 0.3	1.203 1.199 0.5	0.424 0.425 -0.2
9	0.355 0.353 0.2	1.189 1.184 0.5	1.126 1.122 0.5	1.028 1.025 0.3	1.282 1.287 -0.5	1.045 1.050 -0.5	1.303 1.316 -1.4	1.047 1.063 -1.5	1.303 1.335 -3.3	1.036 1.047 -1.1	1.270 1.275 -0.5	1.026 1.026 0.0	1.130 1.128 0.2	1.193 1.192 0.1	0.357 0.365 -0.8
10		0.987 0.984 0.3	1.274 1.271 0.3	1.020 1.017 0.3	1.036 1.035 0.1	0.961 0.961 -0.1	1.036 1.041 -0.5	1.032 1.035 -0.3	1.045 1.053 -0.8	0.961 0.964 -0.4	1.015 1.015 0.0	1.016 1.013 0.3	1.274 1.272 0.2	0.988 0.983 0.5	
11		0.421 0.420 0.2	1.163 1.161 0.3	1.271 1.267 0.4	0.986 0.978 0.7	1.015 1.010 0.6	1.270 1.261 0.9	1.100 1.083 1.6	1.282 1.278 0.4	1.036 1.033 0.3	0.986 0.980 0.5	1.269 1.267 0.2	1.163 1.163 0.0	0.422 0.420 0.2	
12			0.477 0.477 0.0	1.163 1.160 0.3	1.269 1.264 0.6	1.017 1.009 0.8	1.026 1.011 1.5	1.277 1.266 1.1	1.027 1.023 0.5	1.020 1.017 0.3	1.271 1.268 0.3	1.163 1.162 0.0	0.477 0.482 -0.5		
13				0.477 0.476 0.2	1.163 1.160 0.3	1.274 1.269 0.5	1.130 1.123 0.7	1.106 1.102 0.5	1.126 1.125 0.1	1.274 1.271 0.3	1.163 1.161 0.2	0.477 0.476 0.1			
14					0.422 0.424 -0.2	0.988 0.987 0.2	1.193 1.191 0.2	1.203 1.205 -0.1	1.189 1.198 -0.9	0.987 0.989 -0.2	0.421 0.421 0.0				
15							0.357 0.356 0.1	0.424 0.424 0.0	0.355 0.356 -0.2						

Calculated Power
Measured Power
Difference (C-M)*100

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure A 10.4.1-47: Plant A EOC 11 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.373 0.376 -0.3	0.443 0.448 -0.5	0.375 0.377 -0.2						
2					0.456 0.457 -0.1	0.981 0.985 -0.4	1.118 1.125 -0.7	1.152 1.160 -0.7	1.120 1.126 -0.6	0.981 0.986 -0.5	0.456 0.458 -0.2				
3				0.520 0.524 -0.4	1.165 1.167 -0.1	1.315 1.320 -0.4	1.084 1.091 -0.7	1.059 1.064 -0.5	1.086 1.091 -0.4	1.316 1.321 -0.5	1.166 1.170 -0.4	0.521 0.525 -0.4			
4			0.521 0.520 0.1	1.190 1.188 0.1	1.353 1.347 0.6	1.031 1.031 0.0	1.020 1.022 -0.3	1.319 1.318 0.1	1.020 1.022 -0.3	1.029 1.031 -0.3	1.352 1.354 -0.2	1.190 1.189 0.1	0.520 0.520 0.0		
5		0.456 0.453 0.3	1.166 1.163 0.3	1.352 1.350 0.2	1.009 1.010 0.0	1.030 1.033 -0.3	1.284 1.292 -0.8	1.078 1.088 -1.0	1.278 1.286 -0.8	1.014 1.015 -0.1	1.009 1.007 0.2	1.353 1.343 1.0	1.165 1.167 -0.2	0.456 0.469 -1.3	
6		0.981 0.972 0.9	1.316 1.304 1.2	1.029 1.024 0.4	1.014 1.022 -0.8	0.946 0.951 -0.4	1.012 1.022 -1.0	0.997 1.029 -3.2	1.006 1.016 -0.9	0.946 0.945 0.1	1.030 1.029 0.1	1.031 1.029 0.2	1.315 1.317 -0.2	0.981 0.984 -0.4	
7	0.375 0.373 0.2	1.120 1.107 1.3	1.086 1.063 2.3	1.020 1.008 1.2	1.278 1.270 0.8	1.006 1.004 0.3	1.262 1.264 -0.2	1.005 1.015 -0.9	1.262 1.267 -0.5	1.012 1.013 -0.1	1.284 1.286 -0.2	1.020 1.024 -0.4	1.084 1.085 -0.1	1.118 1.113 0.4	0.373 0.370 0.3
8	0.443 0.447 -0.4	1.152 1.145 0.8	1.059 1.046 1.3	1.319 1.303 1.6	1.078 1.054 2.4	0.997 0.990 0.7	1.005 1.005 0.0	1.310 1.319 -0.9	1.005 1.013 -0.8	0.997 0.996 0.1	1.078 1.078 0.0	1.319 1.322 -0.3	1.059 1.062 -0.4	1.152 1.135 1.7	0.443 0.437 0.6
9	0.373 0.373 0.0	1.118 1.114 0.4	1.084 1.078 0.6	1.020 1.013 0.6	1.284 1.280 0.4	1.012 1.009 0.3	1.262 1.263 -0.1	1.005 1.012 -0.7	1.262 1.288 -2.6	1.006 1.005 0.2	1.278 1.277 0.1	1.020 1.017 0.2	1.086 1.084 0.2	1.120 1.114 0.7	0.375 0.372 0.3
10		0.981 0.980 0.1	1.315 1.316 0.0	1.031 1.029 0.2	1.030 1.027 0.3	0.946 0.943 0.4	1.006 1.002 0.4	0.997 0.998 -0.1	1.012 1.017 -0.5	0.946 0.946 0.1	1.014 1.011 0.3	1.029 1.021 0.7	1.316 1.312 0.3	0.981 0.982 -0.1	
11		0.456 0.457 -0.1	1.165 1.173 -0.8	1.353 1.356 -0.3	1.009 1.005 0.4	1.014 1.008 0.6	1.278 1.269 1.0	1.078 1.074 0.4	1.284 1.282 0.1	1.030 1.026 0.4	1.009 1.007 0.3	1.352 1.347 0.5	1.166 1.163 0.3	0.456 0.456 0.1	
12			0.520 0.539 -1.9	1.190 1.197 -0.7	1.352 1.351 0.1	1.029 1.022 0.6	1.020 1.001 1.9	1.319 1.312 0.7	1.020 1.017 0.3	1.031 1.025 0.6	1.353 1.347 0.6	1.190 1.185 0.4	0.521 0.520 0.1		
13				0.521 0.522 -0.1	1.166 1.165 0.1	1.316 1.313 0.3	1.086 1.083 0.3	1.059 1.059 -0.1	1.084 1.087 -0.3	1.315 1.303 1.3	1.165 1.159 0.7	0.520 0.517 0.3			
14					0.456 0.456 0.0	0.981 0.983 -0.1	1.120 1.126 -0.6	1.152 1.164 -1.2	1.118 1.143 -2.6	0.981 0.985 -0.4	0.456 0.455 0.1				
15							0.375 0.385 -1.0	0.443 0.450 -0.7	0.373 0.381 -0.8						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-48: Plant A BOC 12 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.280 0.281 -0.1	0.345 0.350 -0.5	0.283 0.286 -0.3						
2					0.324 0.322 0.2	0.686 0.685 0.1	1.041 1.045 -0.4	1.023 1.031 -0.8	1.046 1.056 -1.0	0.685 0.691 -0.6	0.320 0.323 -0.3				
3				0.392 0.389 0.2	0.963 0.955 0.8	1.136 1.132 0.3	1.164 1.166 -0.2	1.272 1.284 -1.3	1.161 1.173 -1.3	1.136 1.149 -1.2	0.964 0.975 -1.1	0.392 0.400 -0.8			
4			0.392 0.387 0.5	0.988 0.976 1.3	1.167 1.149 1.8	1.260 1.253 0.7	1.228 1.234 -0.6	1.179 1.203 -2.4	1.231 1.243 -1.2	1.265 1.276 -1.1	1.172 1.183 -1.1	0.988 0.993 -0.4	0.392 0.392 0.0		
5		0.320 0.316 0.4	0.964 0.954 1.0	1.172 1.156 1.5	1.273 1.249 2.4	1.248 1.239 0.9	1.189 1.197 -0.8	1.281 1.283 -0.2	1.199 1.205 -0.5	1.256 1.264 -0.8	1.273 1.285 -1.2	1.167 1.160 0.7	0.963 0.963 0.0	0.324 0.327 -0.3	
6		0.685 0.676 0.9	1.136 1.123 1.4	1.265 1.249 1.6	1.255 1.239 1.6	1.184 1.175 0.9	1.245 1.234 1.0	1.263 1.236 2.8	1.252 1.247 0.5	1.184 1.192 -0.8	1.249 1.253 -0.5	1.260 1.261 0.0	1.136 1.140 -0.4	0.686 0.690 -0.5	
7	0.283 0.280 0.3	1.046 1.034 1.2	1.161 1.144 1.7	1.231 1.217 1.4	1.199 1.190 0.9	1.252 1.243 0.9	1.197 1.189 0.8	1.250 1.238 1.2	1.197 1.197 0.1	1.245 1.246 -0.1	1.189 1.192 -0.2	1.228 1.229 -0.1	1.164 1.170 -0.6	1.041 1.054 -1.3	0.280 0.282 -0.3
8	0.345 0.345 0.0	1.022 1.014 0.8	1.272 1.261 1.1	1.179 1.173 0.6	1.281 1.276 0.6	1.263 1.257 0.7	1.250 1.242 0.8	1.242 1.233 0.9	1.250 1.244 0.6	1.263 1.260 0.3	1.281 1.280 0.1	1.179 1.180 -0.1	1.272 1.274 -0.3	1.023 1.022 0.1	0.345 0.346 -0.1
9	0.280 0.279 0.1	1.041 1.036 0.5	1.164 1.160 0.4	1.228 1.226 0.2	1.189 1.194 -0.5	1.245 1.242 0.3	1.197 1.192 0.5	1.250 1.241 0.9	1.197 1.188 1.0	1.252 1.247 0.5	1.199 1.197 0.2	1.231 1.227 0.3	1.161 1.163 -0.2	1.046 1.050 -0.4	0.283 0.286 -0.3
10		0.685 0.684 0.2	1.135 1.136 0.0	1.260 1.259 0.1	1.248 1.248 0.0	1.184 1.182 0.2	1.252 1.246 0.6	1.263 1.254 0.9	1.245 1.237 0.7	1.184 1.181 0.3	1.255 1.252 0.4	1.265 1.255 1.0	1.136 1.139 -0.2	0.685 0.693 -0.8	
11		0.324 0.324 0.0	0.963 0.966 -0.3	1.167 1.169 -0.2	1.273 1.272 0.1	1.255 1.253 0.3	1.199 1.195 0.5	1.281 1.267 1.4	1.189 1.186 0.3	1.248 1.247 0.1	1.273 1.276 -0.3	1.172 1.175 -0.4	0.964 0.969 -0.5	0.320 0.322 -0.2	
12			0.392 0.400 -0.8	0.988 0.993 -0.5	1.172 1.174 -0.3	1.265 1.266 0.0	1.231 1.229 0.2	1.179 1.180 0.0	1.228 1.231 -0.3	1.260 1.265 -0.5	1.167 1.176 -0.9	0.988 1.002 -1.3	0.392 0.398 -0.6		
13				0.392 0.393 -0.1	0.964 0.967 -0.3	1.136 1.141 -0.5	1.161 1.167 -0.7	1.272 1.280 -0.9	1.164 1.177 -1.3	1.136 1.147 -1.1	0.963 0.972 -0.9	0.392 0.396 -0.4			
14					0.320 0.321 -0.2	0.685 0.689 -0.4	1.046 1.057 -1.1	1.022 1.036 -1.4	1.041 1.067 -2.6	0.686 0.696 -1.1	0.324 0.328 -0.3				
15							0.283 0.292 -0.9	0.345 0.351 -0.6	0.280 0.286 -0.6						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-49: Plant A MOC 12 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.286 0.282 0.4	0.339 0.337 0.2	0.288 0.287 0.1						
2					0.364 0.359 0.5	0.727 0.717 1.0	1.092 1.078 1.4	0.968 0.963 0.5	1.095 1.093 0.2	0.725 0.723 0.1	0.359 0.359 0.0				
3				0.439 0.441 -0.1	1.113 1.100 1.3	1.298 1.281 1.7	1.322 1.296 2.6	1.231 1.229 0.1	1.319 1.319 0.0	1.297 1.295 0.2	1.113 1.115 -0.1	0.439 0.446 -0.7			
4			0.439 0.432 0.8	1.111 1.097 1.3	1.286 1.266 2.0	1.187 1.176 1.1	1.168 1.167 0.1	1.288 1.315 -2.7	1.169 1.174 -0.5	1.190 1.181 0.9	1.289 1.288 0.1	1.111 1.112 -0.2	0.439 0.440 0.0		
5		0.359 0.353 0.6	1.113 1.091 2.2	1.289 1.273 1.6	1.160 1.149 1.1	1.114 1.109 0.5	1.219 1.227 -0.7	1.145 1.152 -0.7	1.228 1.234 -0.6	1.118 1.121 -0.3	1.160 1.161 -0.1	1.286 1.285 0.1	1.113 1.114 0.0	0.364 0.369 -0.6	
6		0.725 0.716 0.9	1.297 1.280 1.7	1.190 1.178 1.2	1.118 1.113 0.6	1.198 1.195 0.4	1.074 1.072 0.2	1.040 1.031 0.9	1.080 1.085 -0.5	1.198 1.212 -1.4	1.114 1.116 -0.3	1.187 1.184 0.3	1.298 1.293 0.5	0.727 0.725 0.2	
7	0.288 0.286 0.2	1.095 1.084 1.0	1.318 1.302 1.7	1.169 1.161 0.8	1.228 1.225 0.3	1.080 1.078 0.2	1.126 1.123 0.4	1.003 1.004 0.0	1.127 1.139 -1.3	1.074 1.081 -0.7	1.219 1.219 0.0	1.168 1.159 0.9	1.322 1.310 1.2	1.092 1.085 0.7	0.286 0.284 0.2
8	0.339 0.340 -0.1	0.968 0.965 0.4	1.230 1.226 0.5	1.288 1.288 0.1	1.145 1.148 -0.4	1.040 1.042 -0.2	1.003 1.004 -0.1	0.970 0.972 -0.2	1.003 1.008 -0.5	1.040 1.043 -0.2	1.145 1.142 0.3	1.288 1.278 1.1	1.231 1.206 2.4	0.968 0.962 0.6	0.339 0.338 0.1
9	0.286 0.286 0.0	1.092 1.092 0.0	1.322 1.324 -0.2	1.168 1.173 -0.5	1.219 1.237 -1.7	1.074 1.081 -0.6	1.126 1.130 -0.4	1.003 1.006 -0.3	1.126 1.131 -0.4	1.080 1.081 -0.1	1.228 1.227 0.1	1.169 1.163 0.5	1.318 1.309 0.9	1.095 1.092 0.3	0.288 0.292 -0.4
10		0.727 0.729 -0.2	1.298 1.303 -0.6	1.187 1.192 -0.5	1.114 1.119 -0.5	1.198 1.203 -0.5	1.080 1.083 -0.3	1.040 1.043 -0.3	1.074 1.076 -0.2	1.198 1.199 -0.1	1.118 1.119 -0.1	1.190 1.189 0.1	1.297 1.297 0.1	0.725 0.726 -0.1	
11		0.364 0.366 -0.2	1.113 1.122 -0.9	1.286 1.292 -0.6	1.160 1.157 0.3	1.118 1.119 -0.1	1.228 1.230 -0.2	1.145 1.148 -0.3	1.219 1.221 -0.2	1.114 1.111 0.3	1.160 1.166 -0.6	1.289 1.297 -0.8	1.113 1.120 -0.6	0.359 0.360 -0.1	
12			0.439 0.453 -1.4	1.111 1.120 -0.9	1.289 1.294 -0.5	1.190 1.193 -0.3	1.169 1.167 0.2	1.288 1.291 -0.3	1.168 1.171 -0.3	1.187 1.191 -0.4	1.286 1.296 -1.0	1.111 1.128 -1.7	0.439 0.449 -0.9		
13				0.439 0.443 -0.3	1.113 1.123 -0.9	1.297 1.305 -0.8	1.318 1.324 -0.6	1.231 1.235 -0.5	1.322 1.328 -0.6	1.298 1.304 -0.6	1.113 1.121 -0.8	0.439 0.444 -0.5			
14					0.359 0.371 -1.2	0.725 0.732 -0.7	1.095 1.104 -0.9	0.968 0.974 -0.6	1.092 1.098 -0.6	0.727 0.730 -0.4	0.364 0.366 -0.2				
15							0.288 0.296 -0.8	0.339 0.342 -0.3	0.286 0.287 -0.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-50: Plant A EOC 12 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.310 0.312 -0.2	0.364 0.371 -0.7	0.312 0.314 -0.2						
2					0.400 0.402 -0.2	0.738 0.741 -0.3	1.037 1.041 -0.4	0.926 0.930 -0.4	1.039 1.041 -0.1	0.736 0.734 0.2	0.395 0.393 0.2				
3				0.480 0.488 -0.8	1.094 1.102 -0.7	1.276 1.282 -0.6	1.275 1.276 -0.2	1.156 1.159 -0.3	1.273 1.271 0.1	1.275 1.269 0.6	1.093 1.089 0.4	0.480 0.482 -0.3			
4			0.480 0.481 -0.1	1.125 1.132 -0.8	1.259 1.265 -0.5	1.133 1.140 -0.7	1.129 1.137 -0.8	1.301 1.310 -0.9	1.129 1.127 0.2	1.134 1.119 1.4	1.260 1.252 0.8	1.125 1.120 0.4	0.480 0.478 0.2		
5		0.395 0.395 0.0	1.093 1.095 -0.1	1.260 1.268 -0.7	1.115 1.123 -0.8	1.097 1.107 -1.0	1.274 1.292 -1.8	1.143 1.148 -0.5	1.278 1.277 0.1	1.099 1.091 0.8	1.115 1.108 0.8	1.259 1.253 0.6	1.094 1.088 0.6	0.400 0.400 0.1	
6		0.736 0.739 -0.2	1.275 1.280 -0.5	1.134 1.143 -0.9	1.099 1.119 -2.0	1.273 1.286 -1.3	1.107 1.114 -0.7	1.065 1.060 0.4	1.111 1.110 0.0	1.273 1.262 1.1	1.097 1.088 0.9	1.133 1.123 1.0	1.276 1.265 1.1	0.738 0.732 0.6	
7	0.312 0.314 -0.2	1.039 1.043 -0.4	1.273 1.275 -0.3	1.129 1.135 -0.6	1.278 1.290 -1.2	1.111 1.118 -0.7	1.243 1.247 -0.4	1.057 1.061 -0.4	1.243 1.259 -1.5	1.107 1.105 0.2	1.274 1.264 1.0	1.129 1.112 1.7	1.275 1.261 1.3	1.037 1.026 1.1	0.310 0.306 0.4
8	0.364 0.369 -0.4	0.926 0.931 -0.5	1.156 1.161 -0.4	1.301 1.308 -0.7	1.143 1.150 -0.7	1.065 1.069 -0.4	1.057 1.059 -0.2	1.026 1.028 -0.2	1.057 1.060 -0.2	1.065 1.062 0.3	1.143 1.136 0.8	1.301 1.289 1.2	1.156 1.148 0.8	0.926 0.913 1.4	0.364 0.360 0.4
9	0.310 0.312 -0.2	1.037 1.042 -0.5	1.275 1.280 -0.5	1.129 1.133 -0.4	1.274 1.281 -0.6	1.107 1.110 -0.2	1.243 1.244 -0.1	1.057 1.056 0.1	1.243 1.241 0.3	1.111 1.106 0.5	1.278 1.271 0.7	1.129 1.119 1.0	1.273 1.262 1.0	1.039 1.030 0.9	0.312 0.312 0.0
10		0.738 0.741 -0.3	1.276 1.281 -0.5	1.133 1.135 -0.2	1.097 1.097 0.0	1.273 1.272 0.1	1.111 1.109 0.2	1.065 1.061 0.3	1.107 1.103 0.5	1.273 1.266 0.7	1.099 1.094 0.5	1.134 1.122 1.2	1.275 1.265 0.9	0.736 0.730 0.6	
11		0.400 0.402 -0.2	1.094 1.100 -0.5	1.259 1.260 -0.1	1.115 1.108 0.7	1.099 1.095 0.4	1.278 1.273 0.5	1.143 1.137 0.6	1.274 1.268 0.6	1.097 1.086 1.1	1.115 1.122 -0.6	1.260 1.256 0.4	1.093 1.090 0.3	0.395 0.393 0.2	
12			0.480 0.489 -0.9	1.125 1.127 -0.2	1.260 1.257 0.3	1.134 1.130 0.4	1.129 1.123 0.6	1.301 1.298 0.3	1.129 1.127 0.2	1.133 1.131 0.2	1.259 1.259 0.0	1.125 1.120 0.5	0.480 0.485 -0.5		
13				0.480 0.479 0.0	1.093 1.091 0.2	1.275 1.273 0.2	1.273 1.272 0.1	1.156 1.158 -0.2	1.275 1.280 -0.5	1.276 1.279 -0.3	1.094 1.096 -0.1	0.480 0.479 0.1			
14					0.395 0.393 0.2	0.736 0.736 0.0	1.039 1.043 -0.4	0.926 0.932 -0.6	1.037 1.053 -1.6	0.738 0.744 -0.5	0.400 0.402 -0.1				
15							0.312 0.318 -0.6	0.364 0.368 -0.4	0.310 0.314 -0.4						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure A 10.4.1-51: Plant A BOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.319 0.316 0.3	0.428 0.425 0.3	0.317 0.314 0.3						
2					0.356 0.351 0.6	0.677 0.668 0.9	1.083 1.072 1.1	1.146 1.136 1.0	1.078 1.068 1.1	0.668 0.659 0.9	0.336 0.332 0.4				
3				0.446 0.440 0.5	1.054 1.037 1.7	1.203 1.187 1.6	1.218 1.205 1.3	1.239 1.230 0.9	1.218 1.206 1.1	1.192 1.180 1.2	1.033 1.025 0.8	0.435 0.440 -0.5			
4			0.435 0.425 1.0	0.926 0.906 2.0	1.287 1.261 2.6	1.146 1.128 1.8	1.255 1.243 1.3	1.146 1.136 1.0	1.252 1.242 1.1	1.138 1.123 1.5	1.273 1.259 1.4	0.926 0.917 0.9	0.446 0.441 0.4		
5		0.336 0.328 0.8	1.033 1.009 2.3	1.273 1.242 3.1	1.145 1.103 4.2	1.240 1.220 1.9	1.117 1.108 1.0	1.227 1.222 0.5	1.115 1.108 0.7	1.236 1.225 1.1	1.145 1.128 1.8	1.287 1.268 1.9	1.054 1.046 0.8	0.356 0.355 0.1	
6		0.668 0.652 1.7	1.192 1.165 2.7	1.138 1.118 2.0	1.236 1.226 1.0	1.107 1.101 0.6	1.227 1.227 0.0	1.108 1.110 -0.1	1.226 1.229 -0.3	1.107 1.100 0.7	1.240 1.237 0.3	1.146 1.144 0.2	1.203 1.202 0.1	0.677 0.676 0.1	
7	0.317 0.308 0.8	1.078 1.051 2.7	1.218 1.182 3.6	1.252 1.236 1.6	1.115 1.115 0.0	1.226 1.232 -0.6	1.207 1.218 -1.1	1.122 1.133 -1.2	1.207 1.225 -1.8	1.227 1.245 -1.8	1.117 1.129 -1.1	1.255 1.273 -1.7	1.218 1.223 -0.5	1.083 1.085 -0.1	0.319 0.319 0.0
8	0.428 0.417 1.1	1.146 1.121 2.5	1.239 1.214 2.5	1.146 1.138 0.8	1.227 1.253 -2.6	1.108 1.121 -1.2	1.122 1.137 -1.6	1.216 1.237 -2.1	1.122 1.144 -2.3	1.108 1.146 -3.7	1.227 1.251 -2.3	1.146 1.158 -1.2	1.239 1.242 -0.4	1.146 1.145 0.1	0.428 0.429 -0.2
9	0.319 0.312 0.7	1.083 1.063 2.0	1.218 1.198 2.0	1.255 1.241 1.5	1.117 1.098 1.9	1.227 1.236 -0.9	1.207 1.231 -2.4	1.122 1.144 -2.3	1.207 1.230 -2.3	1.226 1.264 -3.8	1.115 1.132 -1.8	1.252 1.264 -1.2	1.218 1.225 -0.8	1.078 1.086 -0.8	0.317 0.327 -1.0
10		0.677 0.666 1.1	1.203 1.186 1.7	1.146 1.134 1.2	1.240 1.232 0.7	1.107 1.119 -1.2	1.226 1.272 -4.6	1.108 1.140 -3.2	1.227 1.257 -3.0	1.107 1.132 -2.5	1.236 1.245 -0.9	1.138 1.140 -0.2	1.192 1.200 -0.8	0.668 0.676 -0.8	
11		0.356 0.352 0.4	1.054 1.047 0.7	1.287 1.278 0.9	1.145 1.133 1.2	1.236 1.247 -1.1	1.115 1.141 -2.6	1.227 1.268 -4.1	1.117 1.145 -2.8	1.240 1.278 -3.9	1.145 1.129 1.6	1.273 1.273 0.0	1.033 1.040 -0.7	0.336 0.339 -0.3	
12			0.446 0.453 -0.7	0.926 0.926 0.1	1.273 1.273 0.0	1.138 1.146 -0.8	1.252 1.275 -2.3	1.146 1.163 -1.7	1.255 1.274 -1.9	1.146 1.160 -1.4	1.287 1.290 -0.3	0.926 0.930 -0.4	0.435 0.447 -1.2		
13				0.435 0.435 0.0	1.033 1.035 -0.2	1.192 1.199 -0.7	1.218 1.225 -0.7	1.239 1.233 0.6	1.218 1.223 -0.5	1.203 1.210 -0.7	1.054 1.058 -0.4	0.446 0.447 -0.1			
14					0.336 0.337 -0.1	0.668 0.671 -0.3	1.078 1.084 -0.5	1.146 1.148 -0.2	1.083 1.087 -0.3	0.677 0.679 -0.2	0.356 0.357 -0.1				
15							0.317 0.321 -0.4	0.428 0.429 -0.1	0.319 0.320 -0.1						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.6

Figure A 10.4.1-52: Plant A MOC 13 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.307 0.309 -0.2	0.407 0.416 -0.9	0.305 0.307 -0.2						
2					0.363 0.361 0.3	0.659 0.656 0.3	1.046 1.046 0.0	1.105 1.108 -0.3	1.043 1.044 0.0	0.653 0.652 0.1	0.345 0.344 0.1	Calculated Power Measured Power Difference (C-M)*100			
3				0.445 0.448 -0.3	1.099 1.089 0.9	1.279 1.271 0.8	1.125 1.122 0.3	1.105 1.106 -0.2	1.127 1.123 0.4	1.271 1.262 0.9	1.082 1.077 0.6	0.437 0.443 -0.6			
4			0.437 0.433 0.4	0.897 0.888 0.9	1.342 1.321 2.1	1.127 1.117 1.0	1.373 1.367 0.6	1.094 1.093 0.1	1.371 1.362 0.9	1.122 1.103 1.8	1.332 1.318 1.3	0.897 0.895 0.2	0.445 0.445 0.0		
5		0.345 0.343 0.3	1.082 1.074 0.8	1.332 1.319 1.3	1.115 1.096 1.9	1.340 1.329 1.1	1.102 1.096 0.6	1.315 1.311 0.5	1.100 1.093 0.7	1.338 1.322 1.5	1.115 1.098 1.7	1.342 1.342 0.0	1.099 1.102 -0.3	0.363 0.366 -0.3	
6		0.653 0.649 0.4	1.271 1.263 0.8	1.122 1.116 0.5	1.338 1.338 0.0	1.084 1.081 0.3	1.282 1.278 0.3	1.039 1.036 0.2	1.281 1.278 0.3	1.084 1.075 1.0	1.340 1.332 0.8	1.127 1.128 -0.1	1.279 1.286 -0.7	0.659 0.667 -0.8	
7	0.305 0.303 0.2	1.043 1.037 0.7	1.127 1.119 0.8	1.371 1.369 0.2	1.100 1.104 -0.4	1.281 1.284 -0.2	1.089 1.087 0.2	0.996 0.997 -0.1	1.089 1.096 -0.7	1.282 1.278 0.4	1.102 1.100 0.1	1.373 1.381 -0.8	1.125 1.135 -1.0	1.046 1.069 -2.2	0.307 0.313 -0.6
8	0.407 0.406 0.0	1.105 1.098 0.7	1.105 1.095 1.0	1.094 1.094 -0.1	1.315 1.339 -2.3	1.039 1.045 -0.6	0.996 0.999 -0.3	1.230 1.234 -0.4	0.996 0.997 -0.1	1.039 1.029 0.9	1.315 1.314 0.1	1.094 1.096 -0.2	1.105 1.109 -0.4	1.105 1.110 -0.5	0.407 0.412 -0.6
9	0.307 0.305 0.2	1.046 1.040 0.7	1.125 1.118 0.8	1.373 1.365 0.8	1.102 1.091 1.1	1.282 1.284 -0.2	1.089 1.097 -0.7	0.996 1.002 -0.6	1.089 1.092 -0.3	1.281 1.299 -1.7	1.100 1.103 -0.2	1.371 1.371 0.0	1.127 1.130 -0.3	1.043 1.052 -0.9	0.305 0.318 -1.4
10		0.659 0.655 0.4	1.279 1.269 0.9	1.127 1.120 0.7	1.340 1.332 0.8	1.084 1.087 -0.3	1.281 1.301 -2.0	1.039 1.052 -1.4	1.282 1.294 -1.2	1.084 1.093 -0.9	1.338 1.335 0.2	1.122 1.112 0.9	1.271 1.271 0.0	0.653 0.658 -0.5	
11		0.363 0.362 0.1	1.099 1.098 0.1	1.342 1.337 0.6	1.115 1.102 1.4	1.338 1.340 -0.2	1.100 1.113 -1.3	1.315 1.344 -2.9	1.102 1.115 -1.3	1.340 1.358 -1.7	1.115 1.104 1.1	1.332 1.329 0.3	1.082 1.084 -0.2	0.345 0.346 -0.1	
12			0.445 0.459 -1.4	0.897 0.899 -0.2	1.332 1.331 0.1	1.122 1.125 -0.4	1.371 1.385 -1.4	1.094 1.102 -0.8	1.373 1.381 -0.8	1.127 1.132 -0.6	1.342 1.344 -0.2	0.897 0.905 -0.8	0.437 0.444 -0.7		
13				0.437 0.438 -0.1	1.082 1.086 -0.3	1.271 1.275 -0.4	1.127 1.129 -0.2	1.105 1.093 1.2	1.125 1.124 0.1	1.279 1.279 -0.1	1.099 1.100 -0.1	0.445 0.447 -0.2			
14					0.345 0.351 -0.6	0.653 0.656 -0.3	1.043 1.047 -0.3	1.105 1.102 0.3	1.046 1.045 0.1	0.659 0.659 0.0	0.363 0.364 0.0				
15							0.305 0.312 -0.7	0.407 0.408 -0.1	0.307 0.307 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure A 10.4.1-53: Plant A EOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.351 0.357 -0.5	0.459 0.470 -1.2	0.350 0.354 -0.4						
2					0.400 0.403 -0.4	0.685 0.691 -0.6	1.042 1.053 -1.1	1.114 1.126 -1.3	1.041 1.047 -0.6	0.682 0.678 0.4	0.384 0.383 0.1				
3				0.479 0.489 -1.0	1.064 1.073 -0.9	1.227 1.237 -1.0	1.077 1.087 -1.0	1.066 1.078 -1.3	1.081 1.085 -0.4	1.226 1.225 0.1	1.057 1.055 0.2	0.474 0.477 -0.4			
4			0.474 0.477 -0.4	0.887 0.894 -0.7	1.271 1.275 -0.4	1.079 1.086 -0.7	1.329 1.339 -1.0	1.066 1.071 -0.5	1.329 1.331 -0.2	1.078 1.074 0.4	1.267 1.260 0.7	0.887 0.883 0.4	0.479 0.477 0.2		
5		0.384 0.387 -0.3	1.057 1.065 -0.9	1.267 1.279 -1.1	1.082 1.091 -0.9	1.357 1.368 -1.1	1.102 1.112 -0.9	1.357 1.362 -0.5	1.102 1.100 0.2	1.357 1.348 0.9	1.082 1.067 1.4	1.271 1.261 1.0	1.064 1.060 0.4	0.400 0.402 -0.2	
6		0.682 0.688 -0.6	1.226 1.238 -1.2	1.078 1.088 -1.0	1.357 1.373 -1.6	1.101 1.109 -0.8	1.350 1.356 -0.6	1.071 1.073 -0.2	1.350 1.346 0.4	1.101 1.090 1.1	1.357 1.345 1.3	1.079 1.071 0.8	1.227 1.224 0.3	0.685 0.687 -0.2	
7	0.350 0.353 -0.3	1.041 1.051 -1.0	1.081 1.092 -1.1	1.329 1.341 -1.2	1.102 1.111 -0.9	1.350 1.356 -0.7	1.115 1.115 0.0	1.025 1.023 0.2	1.115 1.112 0.3	1.350 1.338 1.2	1.102 1.093 1.0	1.329 1.321 0.8	1.077 1.077 0.0	1.042 1.052 -1.0	0.351 0.354 -0.3
8	0.459 0.464 -0.5	1.114 1.122 -0.9	1.066 1.073 -0.7	1.066 1.073 -0.7	1.357 1.370 -1.3	1.071 1.074 -0.3	1.025 1.023 0.2	1.273 1.267 0.6	1.025 1.016 0.9	1.071 1.055 1.6	1.357 1.344 1.3	1.066 1.059 0.7	1.066 1.066 0.0	1.114 1.116 -0.2	0.459 0.463 -0.5
9	0.351 0.354 -0.2	1.042 1.047 -0.5	1.077 1.080 -0.3	1.329 1.332 -0.4	1.102 1.102 0.0	1.350 1.348 0.2	1.115 1.109 0.6	1.025 1.017 0.8	1.115 1.101 1.5	1.350 1.332 1.8	1.102 1.090 1.2	1.329 1.320 1.0	1.081 1.078 0.2	1.041 1.046 -0.5	0.350 0.363 -1.4
10		0.685 0.686 -0.1	1.227 1.225 0.2	1.079 1.079 0.0	1.357 1.356 0.1	1.101 1.096 0.4	1.350 1.336 1.4	1.071 1.063 0.8	1.350 1.337 1.3	1.101 1.089 1.2	1.357 1.343 1.5	1.078 1.066 1.2	1.226 1.221 0.5	0.682 0.684 -0.1	
11		0.400 0.401 -0.1	1.064 1.068 -0.4	1.271 1.273 -0.2	1.082 1.081 0.0	1.357 1.354 0.3	1.102 1.097 0.5	1.357 1.354 0.3	1.102 1.095 0.8	1.357 1.344 1.3	1.082 1.068 1.4	1.267 1.259 0.9	1.057 1.053 0.3	0.384 0.383 0.1	
12			0.479 0.490 -1.1	0.887 0.890 -0.4	1.267 1.268 -0.1	1.078 1.076 0.2	1.329 1.325 0.4	1.066 1.061 0.5	1.329 1.322 0.7	1.079 1.072 0.7	1.271 1.263 0.8	0.887 0.885 0.1	0.474 0.476 -0.3		
13				0.474 0.474 -0.1	1.057 1.057 0.0	1.226 1.225 0.1	1.081 1.078 0.3	1.066 1.059 0.7	1.077 1.072 0.5	1.227 1.223 0.3	1.064 1.060 0.4	0.479 0.478 0.2			
14					0.384 0.384 0.0	0.682 0.682 0.0	1.041 1.043 -0.2	1.114 1.112 0.2	1.042 1.039 0.3	0.685 0.683 0.2	0.400 0.398 0.2				
15							0.350 0.359 -0.9	0.459 0.460 -0.2	0.351 0.351 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure A 10.4.1-54: Plant A BOC 14 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.294 0.295 -0.1	0.371 0.378 -0.6	0.296 0.297 -0.1						
2					0.339 0.337 0.2	0.703 0.701 0.2	1.012 1.012 0.1	1.038 1.039 -0.2	1.020 1.018 0.2	0.709 0.704 0.4	0.341 0.339 0.2				
3				0.422 0.419 0.3	1.007 1.001 0.7	1.182 1.177 0.5	1.171 1.168 0.3	1.222 1.225 -0.3	1.180 1.176 0.5	1.185 1.175 1.0	1.010 1.003 0.7	0.423 0.430 -0.7			
4			0.423 0.421 0.2	0.971 0.965 0.6	1.212 1.202 1.0	1.207 1.200 0.7	1.212 1.207 0.5	1.198 1.193 0.5	1.217 1.209 0.8	1.209 1.189 2.1	1.213 1.197 1.5	0.971 0.963 0.8	0.422 0.418 0.3		
5		0.341 0.340 0.1	1.010 1.008 0.2	1.213 1.206 0.6	1.227 1.212 1.5	1.232 1.226 0.7	1.190 1.184 0.6	1.189 1.186 0.2	1.189 1.185 0.4	1.233 1.222 1.1	1.227 1.206 2.1	1.212 1.196 1.6	1.007 1.001 0.7	0.339 0.342 -0.2	
6		0.709 0.708 0.1	1.185 1.184 0.1	1.209 1.208 0.1	1.233 1.238 -0.5	1.194 1.194 0.0	1.174 1.176 -0.2	1.197 1.200 -0.3	1.176 1.184 -0.8	1.194 1.193 0.1	1.232 1.224 0.9	1.207 1.197 1.0	1.182 1.178 0.4	0.703 0.706 -0.3	
7	0.296 0.296 0.0	1.020 1.019 0.0	1.180 1.179 0.1	1.217 1.217 0.0	1.189 1.190 -0.1	1.176 1.179 -0.3	1.291 1.298 -0.7	1.280 1.295 -1.5	1.291 1.324 -3.3	1.174 1.183 -0.9	1.190 1.187 0.3	1.212 1.201 1.1	1.171 1.170 0.1	1.012 1.025 -1.2	0.294 0.297 -0.3
8	0.371 0.371 0.0	1.038 1.039 -0.1	1.222 1.227 -0.5	1.198 1.197 0.1	1.189 1.186 0.3	1.197 1.199 -0.2	1.280 1.288 -0.8	1.256 1.270 -1.4	1.280 1.299 -1.9	1.197 1.203 -0.6	1.189 1.190 -0.1	1.198 1.195 0.3	1.222 1.221 0.0	1.038 1.038 -0.1	0.371 0.374 -0.3
9	0.294 0.294 0.0	1.012 1.012 0.1	1.171 1.169 0.2	1.212 1.207 0.5	1.190 1.175 1.5	1.174 1.175 -0.1	1.291 1.302 -1.1	1.280 1.294 -1.4	1.291 1.313 -2.2	1.176 1.185 -0.9	1.189 1.191 -0.1	1.217 1.217 0.0	1.180 1.182 -0.2	1.020 1.024 -0.4	0.296 0.305 -0.9
10		0.703 0.702 0.2	1.182 1.177 0.5	1.207 1.204 0.3	1.232 1.229 0.3	1.194 1.198 -0.3	1.176 1.193 -1.7	1.197 1.207 -1.0	1.174 1.184 -1.0	1.194 1.198 -0.3	1.233 1.231 0.2	1.209 1.209 0.0	1.185 1.188 -0.3	0.709 0.711 -0.3	
11		0.339 0.339 0.0	1.007 1.009 -0.2	1.212 1.213 -0.1	1.227 1.227 0.0	1.233 1.234 -0.1	1.189 1.191 -0.2	1.189 1.190 -0.1	1.190 1.192 -0.2	1.232 1.233 -0.1	1.227 1.211 1.6	1.213 1.212 0.1	1.010 1.014 -0.4	0.341 0.342 -0.1	
12			0.422 0.432 -1.1	0.971 0.975 -0.4	1.213 1.214 -0.1	1.209 1.207 0.2	1.217 1.208 0.9	1.198 1.195 0.4	1.212 1.211 0.1	1.207 1.206 0.1	1.212 1.210 0.2	0.971 0.980 -0.9	0.423 0.432 -0.9		
13				0.423 0.424 -0.1	1.010 1.012 -0.2	1.185 1.185 0.0	1.180 1.177 0.3	1.222 1.218 0.4	1.171 1.169 0.2	1.182 1.181 0.1	1.007 1.007 0.1	0.422 0.423 -0.2			
14					0.341 0.345 -0.5	0.709 0.710 -0.2	1.020 1.022 -0.2	1.038 1.037 0.0	1.012 1.011 0.1	0.703 0.703 0.1	0.339 0.339 0.0				
15							0.296 0.304 -0.8	0.371 0.373 -0.2	0.294 0.294 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure A 10.4.1-55: Plant A MOC 14 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.296 0.298 -0.3	0.372 0.380 -0.8	0.297 0.299 -0.2						
2					0.355 0.355 0.1	0.685 0.686 -0.1	1.006 1.011 -0.5	1.049 1.056 -0.6	1.010 1.014 -0.3	0.688 0.687 0.1	0.356 0.356 0.0	Calculated Power Measured Power Difference (C-M)*100			
3				0.463 0.461 0.1	1.089 1.086 0.4	1.249 1.250 -0.1	1.074 1.079 -0.5	1.086 1.092 -0.6	1.080 1.081 -0.1	1.250 1.245 0.5	1.090 1.089 0.2	0.464 0.474 -1.1			
4			0.464 0.465 -0.2	1.111 1.109 0.2	1.307 1.298 1.0	1.162 1.161 0.1	1.313 1.320 -0.7	1.124 1.147 -2.3	1.316 1.318 -0.2	1.163 1.147 1.5	1.307 1.296 1.1	1.111 1.106 0.6	0.463 0.460 0.2		
5		0.356 0.359 -0.3	1.090 1.103 -1.2	1.307 1.310 -0.3	1.182 1.176 0.6	1.308 1.305 0.3	1.151 1.147 0.4	1.284 1.288 -0.4	1.149 1.148 0.1	1.308 1.298 1.0	1.182 1.166 1.5	1.307 1.292 1.6	1.089 1.086 0.4	0.355 0.362 -0.7	
6		0.688 0.691 -0.3	1.250 1.258 -0.7	1.163 1.167 -0.4	1.308 1.316 -0.7	1.145 1.145 0.0	1.259 1.257 0.2	1.089 1.085 0.4	1.260 1.260 0.0	1.145 1.139 0.5	1.308 1.298 1.0	1.162 1.154 0.8	1.249 1.248 0.1	0.685 0.690 -0.6	
7	0.297 0.299 -0.2	1.010 1.014 -0.4	1.080 1.082 -0.2	1.316 1.318 -0.2	1.149 1.151 -0.1	1.260 1.261 0.0	1.096 1.096 0.0	1.020 1.021 -0.1	1.096 1.106 -1.0	1.259 1.256 0.3	1.151 1.144 0.6	1.313 1.306 0.8	1.074 1.076 -0.2	1.006 1.023 -1.7	0.296 0.300 -0.4
8	0.372 0.377 -0.5	1.049 1.053 -0.4	1.086 1.089 -0.3	1.124 1.123 0.1	1.284 1.281 0.3	1.089 1.087 0.2	1.020 1.019 0.1	0.943 0.943 0.0	1.020 1.020 -0.1	1.089 1.080 0.9	1.284 1.277 0.7	1.124 1.120 0.4	1.086 1.086 0.0	1.049 1.051 -0.2	0.372 0.376 -0.4
9	0.296 0.297 -0.1	1.006 1.007 -0.1	1.074 1.073 0.2	1.313 1.309 0.4	1.151 1.141 1.0	1.259 1.255 0.4	1.096 1.095 0.1	1.020 1.020 -0.1	1.096 1.098 -0.1	1.260 1.256 0.4	1.149 1.145 0.4	1.316 1.314 0.2	1.080 1.082 -0.2	1.010 1.017 -0.7	0.297 0.308 -1.1
10		0.685 0.683 0.2	1.249 1.242 0.7	1.162 1.159 0.3	1.308 1.304 0.4	1.145 1.143 0.2	1.260 1.261 -0.1	1.089 1.091 -0.2	1.259 1.259 0.0	1.145 1.141 0.3	1.308 1.303 0.5	1.163 1.161 0.2	1.250 1.254 -0.4	0.688 0.694 -0.7	
11		0.355 0.356 0.0	1.089 1.094 -0.4	1.307 1.310 -0.3	1.182 1.182 0.0	1.308 1.308 0.0	1.149 1.150 -0.1	1.284 1.292 -0.9	1.151 1.151 0.0	1.308 1.303 0.5	1.182 1.172 1.0	1.307 1.304 0.3	1.090 1.095 -0.4	0.356 0.358 -0.2	
12			0.463 0.479 -1.7	1.111 1.119 -0.8	1.307 1.310 -0.3	1.163 1.162 0.1	1.316 1.311 0.5	1.124 1.122 0.1	1.313 1.311 0.3	1.162 1.158 0.4	1.307 1.301 0.7	1.111 1.106 0.5	0.464 0.475 -1.1		
13				0.464 0.465 -0.2	1.090 1.092 -0.2	1.250 1.251 0.0	1.080 1.078 0.2	1.086 1.079 0.7	1.074 1.070 0.4	1.249 1.244 0.5	1.089 1.084 0.5	0.463 0.460 0.2			
14					0.356 0.356 0.0	0.688 0.688 -0.1	1.010 1.013 -0.3	1.049 1.048 0.1	1.006 1.004 0.2	0.685 0.682 0.2	0.355 0.354 0.2				
15							0.297 0.308 -1.1	0.372 0.374 -0.2	0.296 0.295 0.0						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

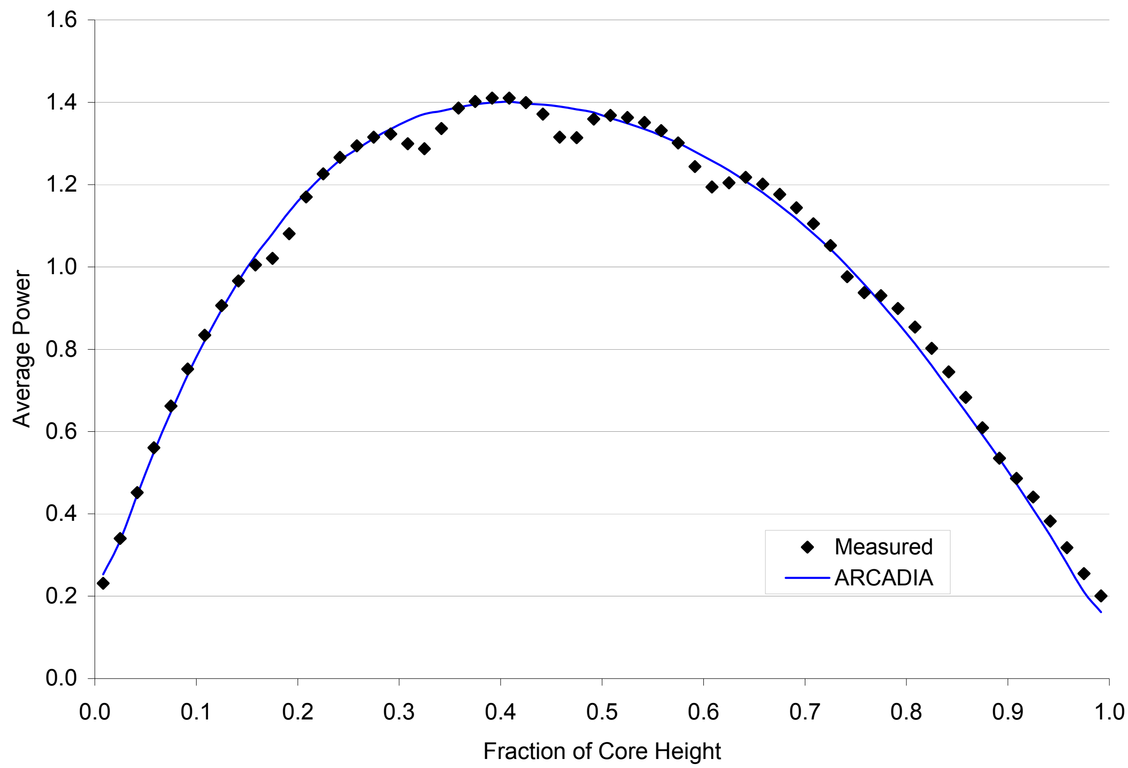
Figure A 10.4.1-56: Plant A EOC 14 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.361 0.366 -0.5	0.452 0.461 -0.9	0.361 0.365 -0.4						
2					0.408 0.410 -0.3	0.737 0.744 -0.7	1.052 1.064 -1.2	1.121 1.133 -1.2	1.054 1.061 -0.7	0.739 0.741 -0.2	0.407 0.408 -0.1				
3				0.517 0.518 -0.1	1.086 1.091 -0.5	1.228 1.237 -0.9	1.060 1.073 -1.4	1.077 1.088 -1.0	1.063 1.066 -0.4	1.227 1.227 0.0	1.086 1.087 -0.2	0.517 0.528 -1.0			
4			0.517 0.517 0.0	1.138 1.140 -0.2	1.259 1.260 -0.2	1.112 1.117 -0.5	1.246 1.254 -0.8	1.085 1.088 -0.4	1.247 1.246 0.1	1.112 1.103 0.9	1.258 1.252 0.6	1.138 1.135 0.3	0.517 0.515 0.1		
5		0.407 0.408 0.0	1.086 1.084 0.2	1.258 1.260 -0.2	1.134 1.137 -0.3	1.276 1.280 -0.5	1.113 1.118 -0.5	1.262 1.262 0.0	1.112 1.110 0.2	1.275 1.268 0.8	1.134 1.121 1.2	1.259 1.247 1.2	1.086 1.083 0.3	0.408 0.412 -0.5	
6		0.739 0.743 -0.4	1.227 1.232 -0.5	1.112 1.116 -0.4	1.275 1.282 -0.7	1.115 1.118 -0.3	1.259 1.260 -0.1	1.079 1.074 0.6	1.259 1.258 0.1	1.115 1.111 0.4	1.276 1.269 0.7	1.112 1.108 0.5	1.228 1.226 0.1	0.737 0.740 -0.3	
7	0.361 0.366 -0.4	1.054 1.063 -0.9	1.063 1.073 -1.0	1.247 1.253 -0.6	1.112 1.115 -0.3	1.259 1.261 -0.2	1.090 1.090 0.0	1.027 1.027 -0.1	1.090 1.098 -0.8	1.259 1.257 0.2	1.113 1.110 0.3	1.246 1.246 0.0	1.060 1.060 -0.1	1.052 1.058 -0.6	0.361 0.363 -0.2
8	0.452 0.460 -0.9	1.121 1.131 -1.0	1.077 1.090 -1.3	1.085 1.088 -0.4	1.262 1.262 0.0	1.079 1.078 0.1	1.027 1.025 0.1	0.962 0.961 0.0	1.027 1.027 -0.1	1.079 1.072 0.7	1.262 1.258 0.5	1.085 1.083 0.2	1.077 1.077 0.0	1.121 1.121 0.0	0.452 0.455 -0.3
9	0.361 0.363 -0.3	1.052 1.055 -0.3	1.060 1.059 0.1	1.246 1.244 0.3	1.113 1.107 0.6	1.259 1.254 0.5	1.090 1.086 0.4	1.027 1.025 0.2	1.090 1.091 -0.2	1.259 1.255 0.4	1.112 1.108 0.4	1.247 1.244 0.3	1.063 1.063 0.0	1.054 1.059 -0.5	0.361 0.373 -1.2
10		0.737 0.733 0.4	1.228 1.211 1.7	1.112 1.106 0.6	1.276 1.270 0.6	1.115 1.109 0.6	1.259 1.250 0.9	1.079 1.074 0.5	1.259 1.255 0.4	1.115 1.110 0.5	1.275 1.268 0.7	1.112 1.107 0.5	1.227 1.227 0.1	0.739 0.742 -0.3	
11		0.408 0.406 0.2	1.086 1.083 0.2	1.259 1.256 0.2	1.134 1.131 0.3	1.275 1.271 0.5	1.112 1.106 0.6	1.262 1.255 0.8	1.113 1.108 0.5	1.276 1.270 0.6	1.134 1.123 1.1	1.258 1.247 1.1	1.086 1.086 0.0	0.407 0.408 -0.1	
12			0.517 0.529 -1.2	1.138 1.142 -0.4	1.258 1.258 0.0	1.112 1.110 0.2	1.247 1.242 0.5	1.085 1.081 0.3	1.246 1.241 0.5	1.112 1.105 0.7	1.259 1.244 1.5	1.138 1.113 2.5	0.517 0.528 -1.1		
13				0.517 0.518 -0.1	1.086 1.087 -0.1	1.227 1.228 -0.1	1.063 1.064 -0.1	1.077 1.081 -0.3	1.060 1.058 0.2	1.228 1.221 0.7	1.086 1.075 1.0	0.517 0.508 0.9			
14					0.407 0.408 -0.1	0.739 0.742 -0.2	1.054 1.061 -0.7	1.121 1.125 -0.4	1.052 1.052 0.0	0.737 0.735 0.3	0.408 0.405 0.3				
15							0.361 0.374 -1.2	0.452 0.456 -0.4	0.361 0.362 -0.1						

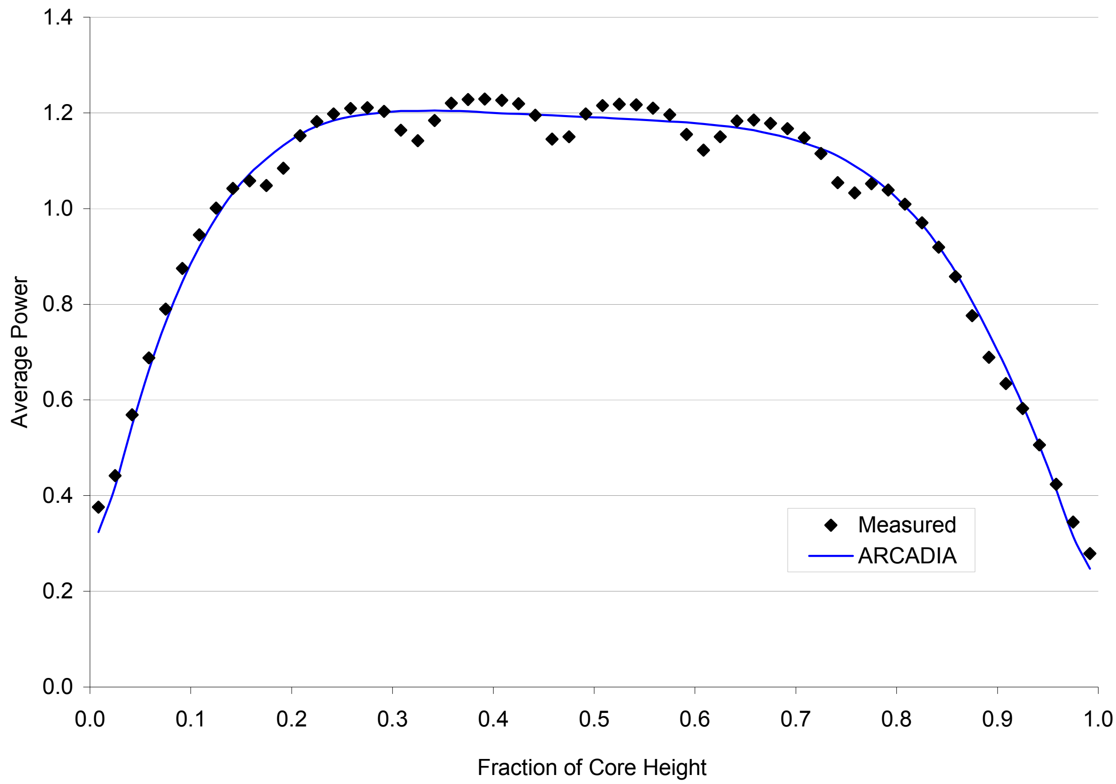
Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure A 10.4.1-57: Plant A BOC 1 Core Average Axial Power Distribution



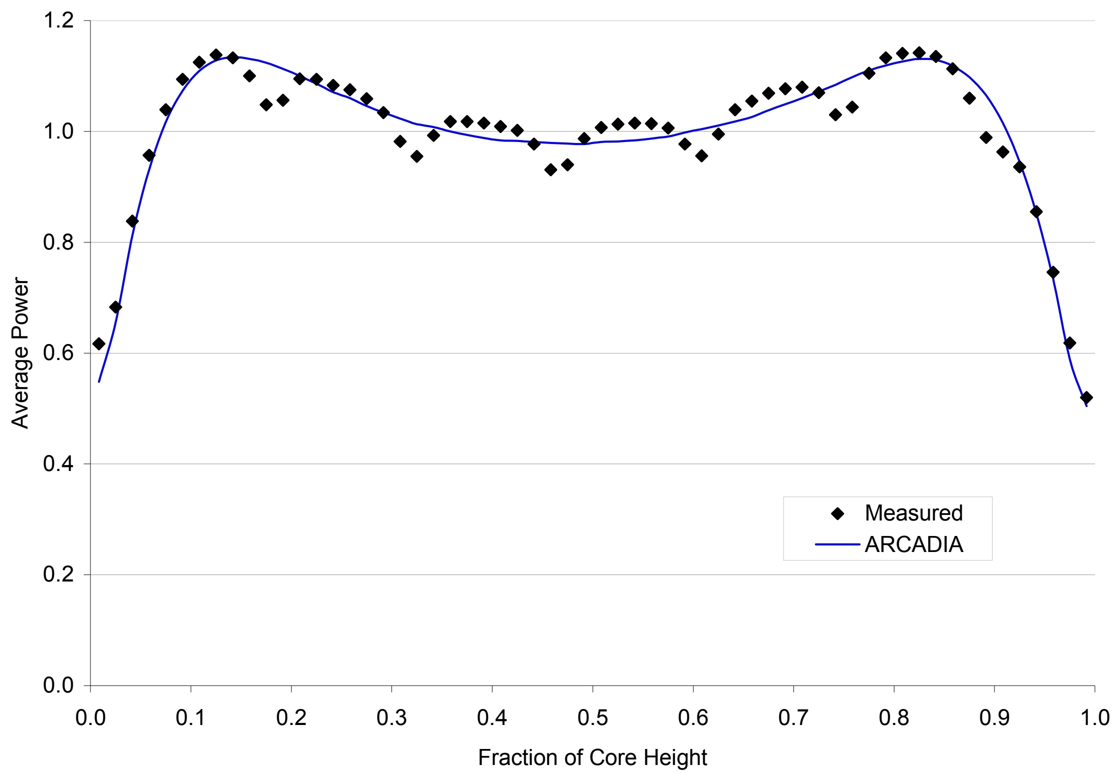
C - M Average Axial Power, RMS Difference *100 = 3.4

Figure A 10.4.1-58: Plant A MOC 1 Core Average Axial Power Distribution



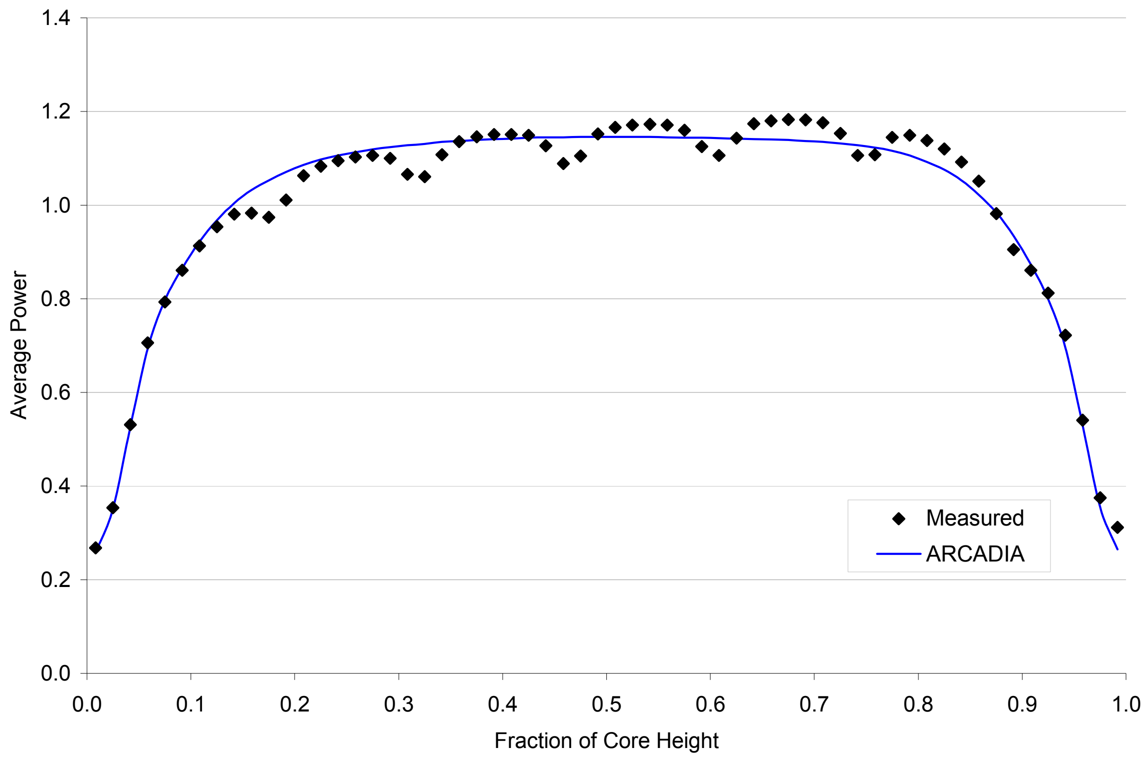
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure A 10.4.1-59: Plant A EOC 1 Core Average Axial Power Distribution



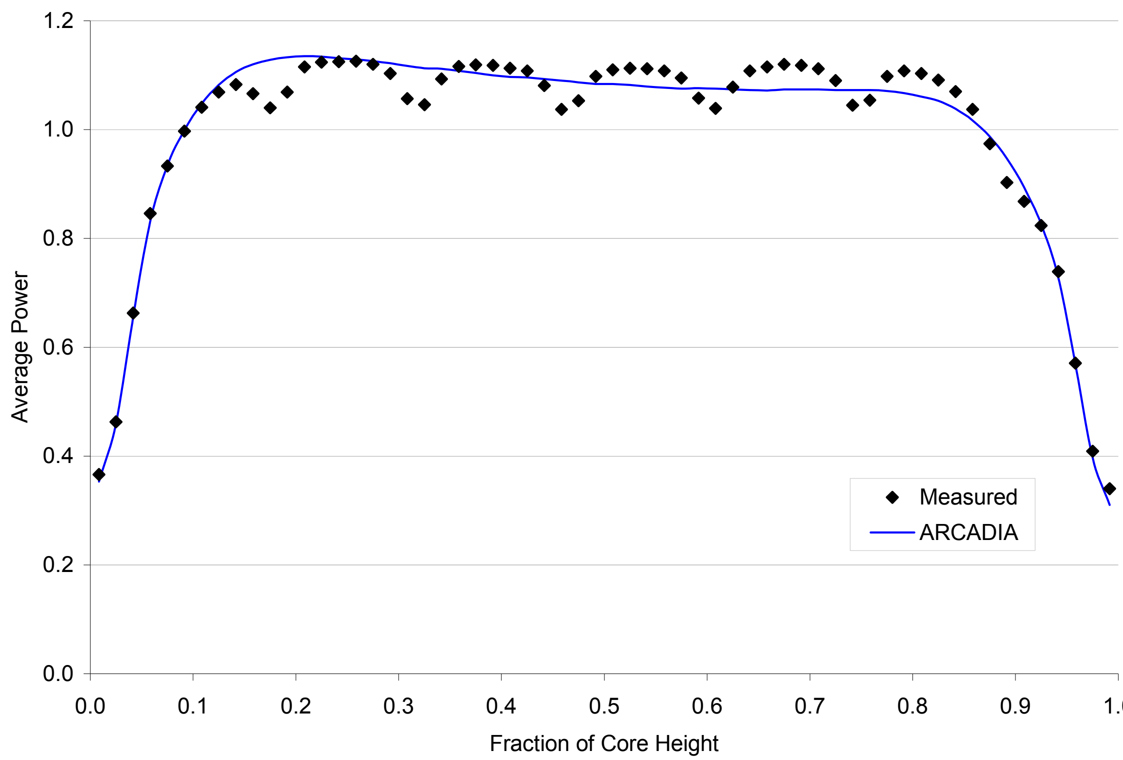
C - M Average Axial Power, RMS Difference *100 = 3.0

Figure A 10.4.1-60: Plant A BOC 2 Core Average Axial Power Distribution



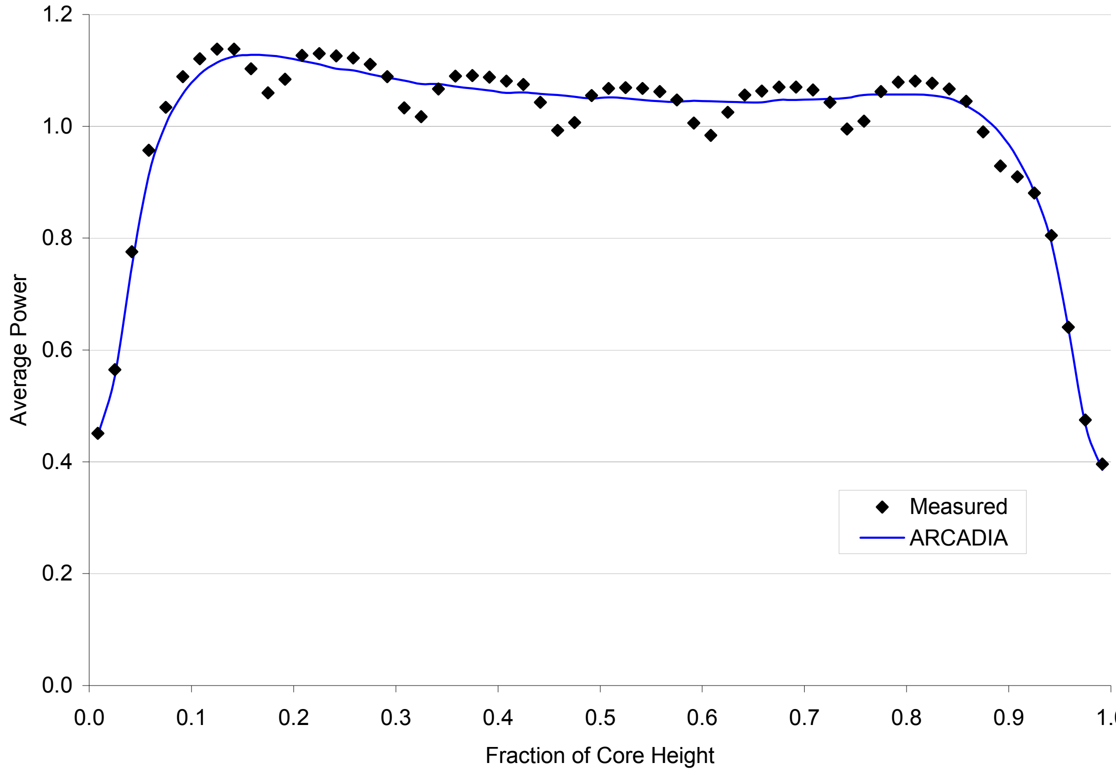
C - M Average Axial Power, RMS Difference *100 = 3.5

Figure A 10.4.1-61: Plant A MOC 2 Core Average Axial Power Distribution



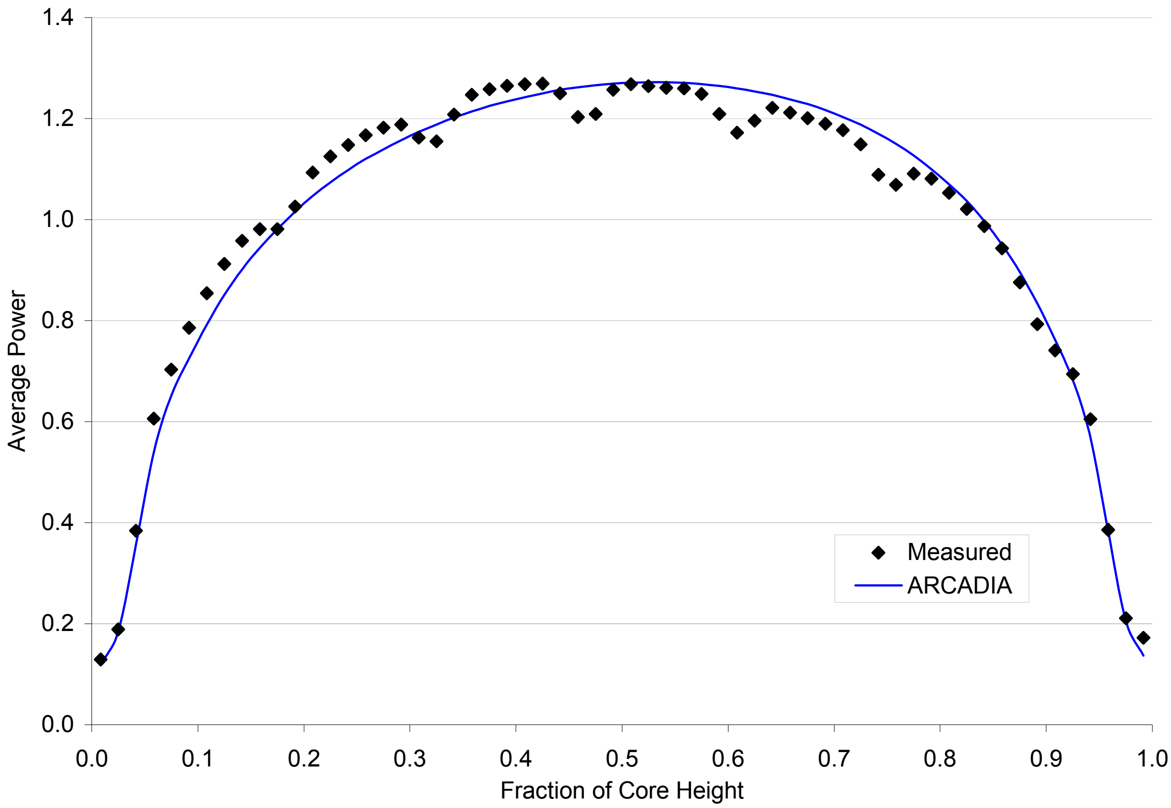
C - M Average Axial Power, RMS Difference *100 = 3.5

Figure A 10.4.1-62: Plant A EOC 2 Core Average Axial Power Distribution



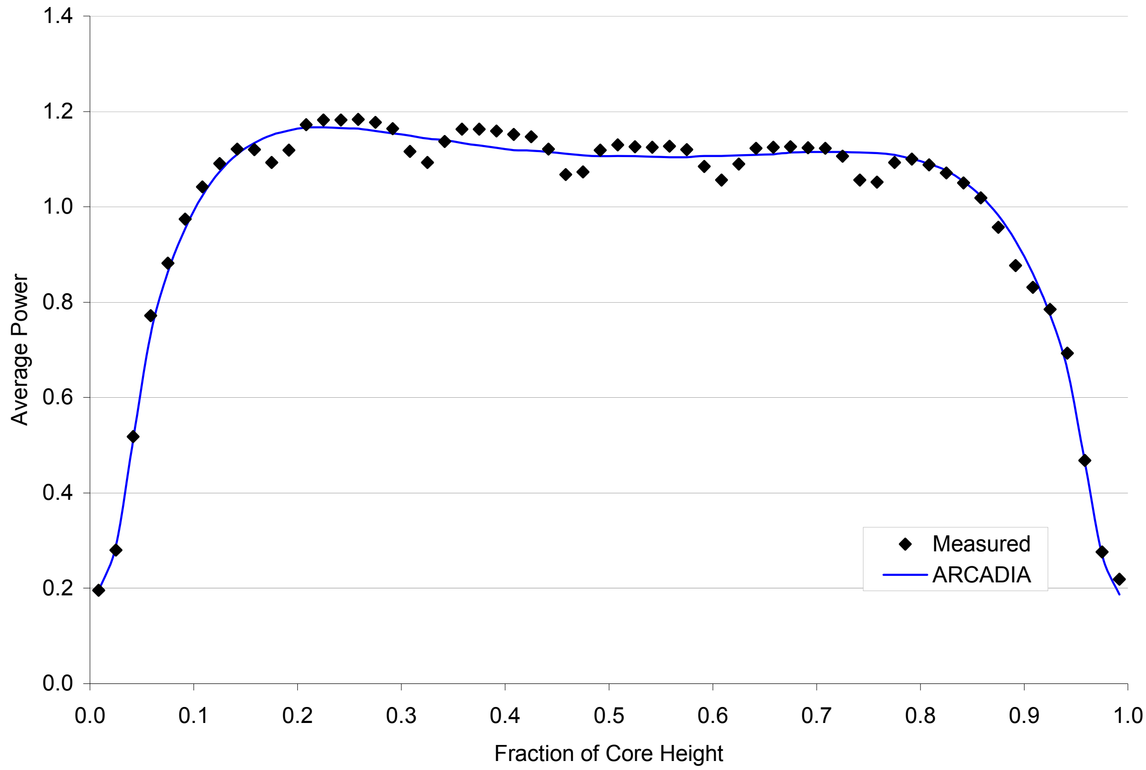
C - M Average Axial Power, RMS Difference *100 = 3.0

Figure A 10.4.1-63: Plant A BOC 3 Core Average Axial Power Distribution



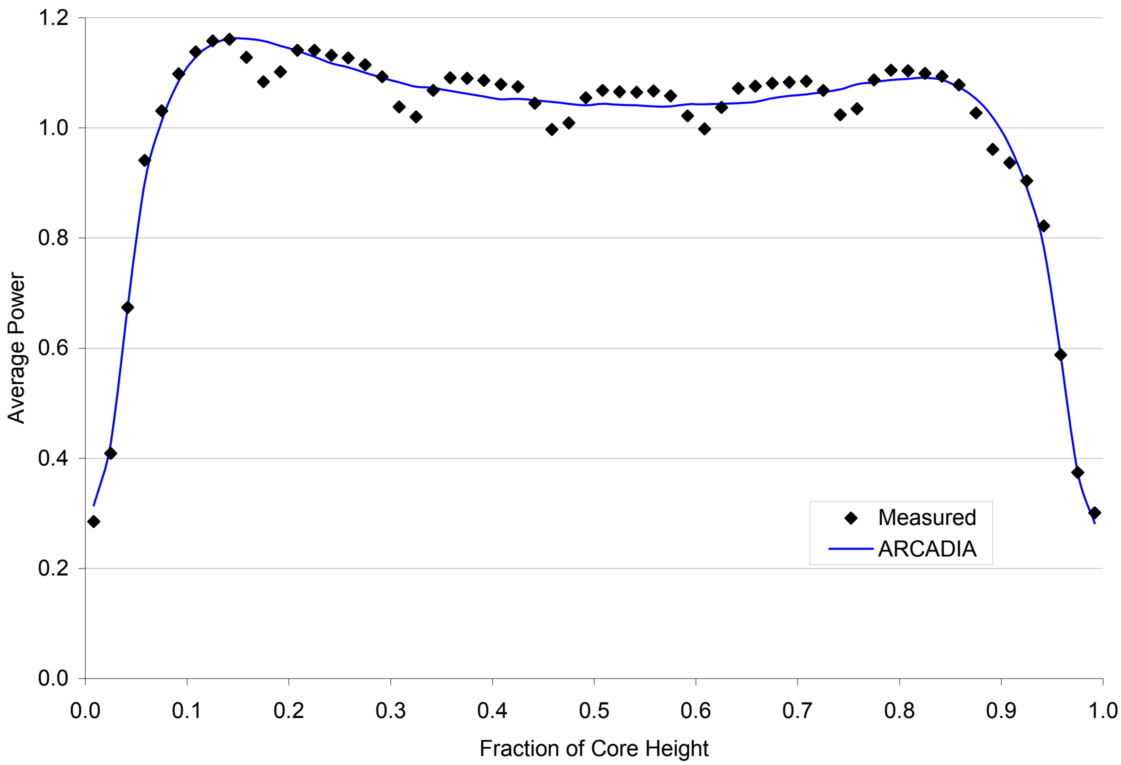
C - M Average Axial Power, RMS Difference *100 = 3.8

Figure A 10.4.1-64: Plant A MOC 3 Core Average Axial Power Distribution



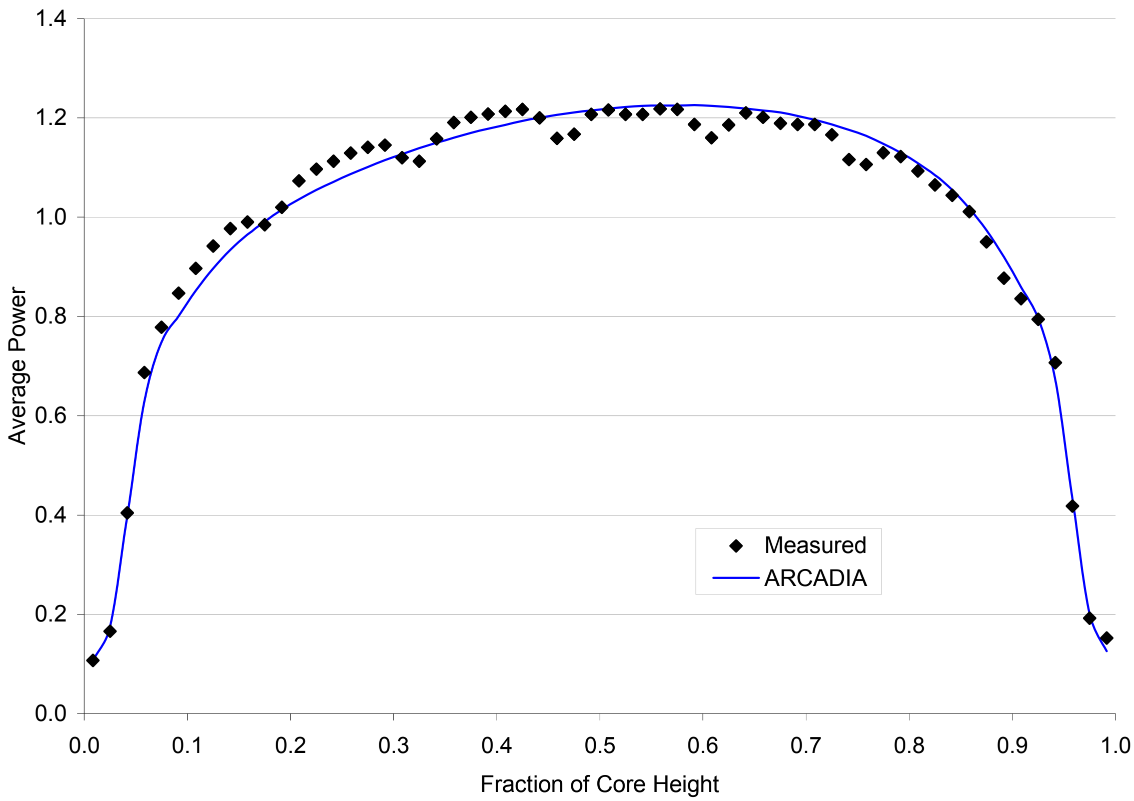
C - M Average Axial Power, RMS Difference *100 = 2.8

Figure A 10.4.1-65: Plant A EOC 3 Core Average Axial Power Distribution



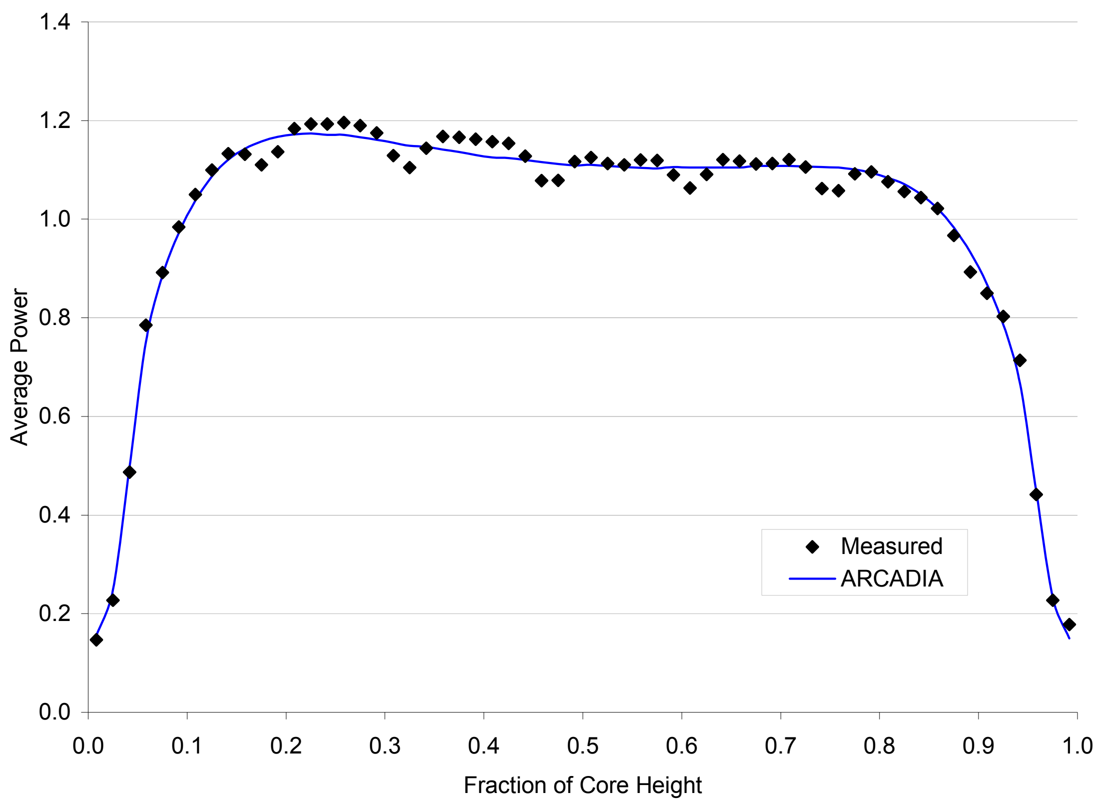
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure A 10.4.1-66: Plant A BOC 4 Core Average Axial Power Distribution



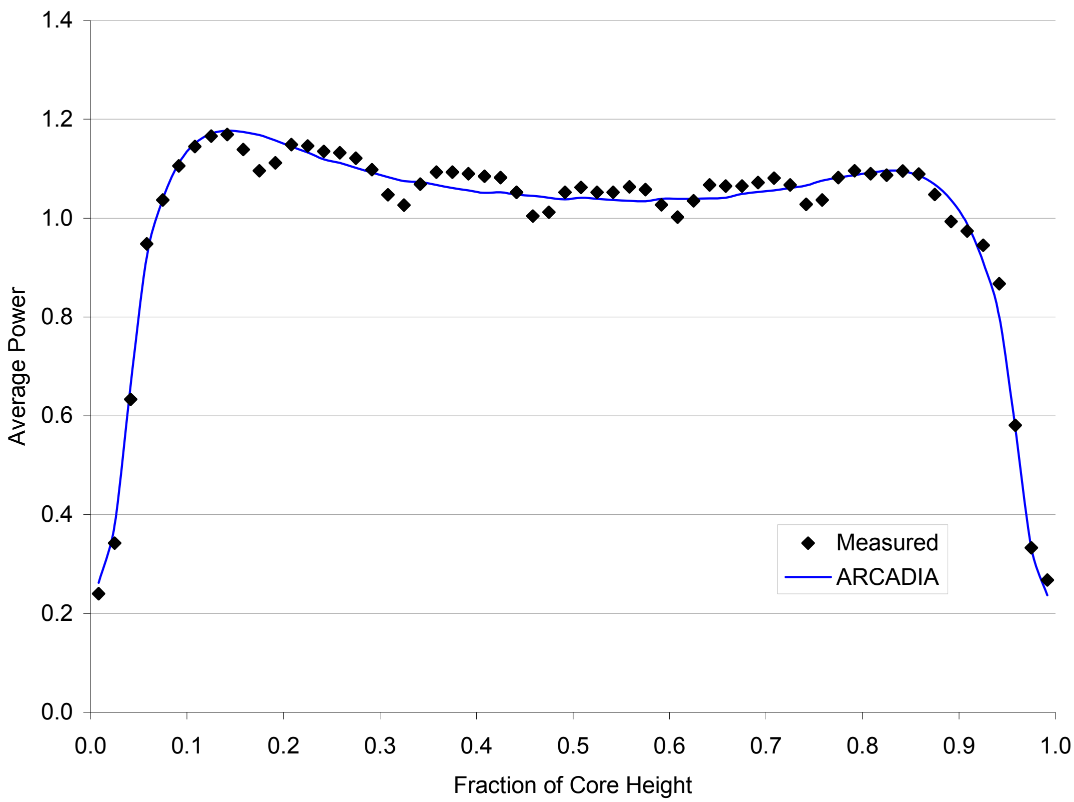
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure A 10.4.1-67: Plant A MOC 4 Core Average Axial Power Distribution



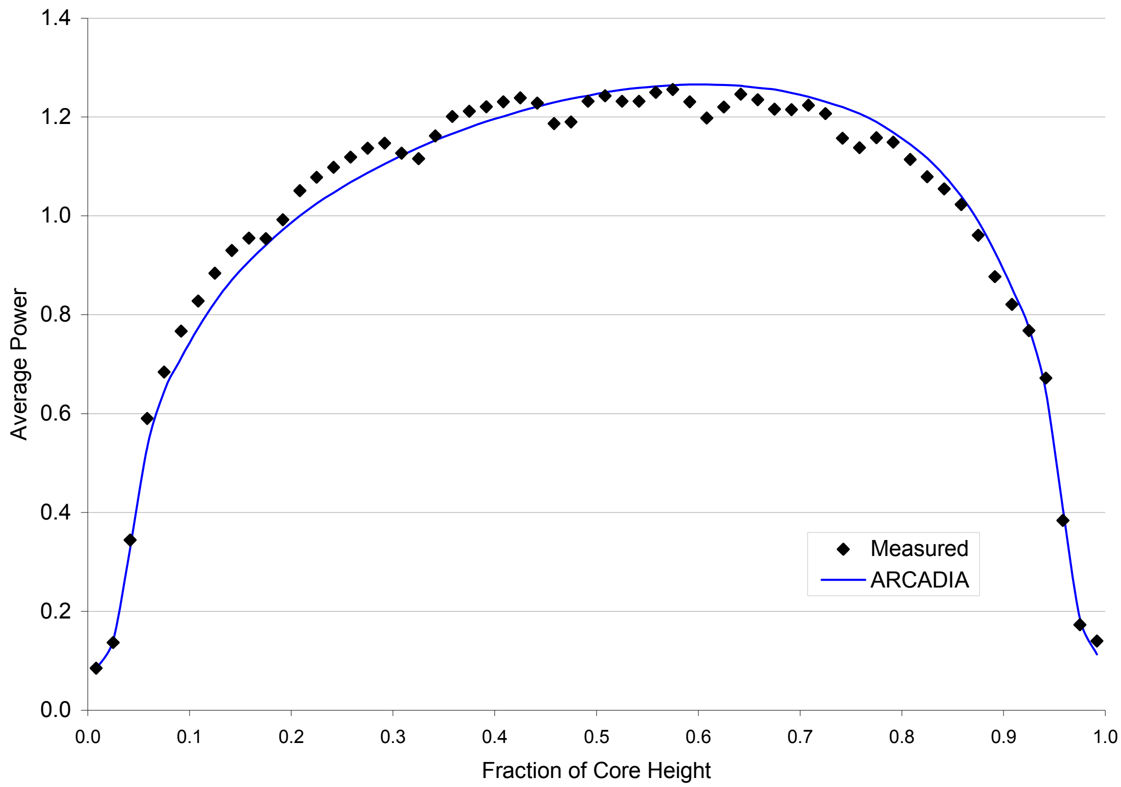
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure A 10.4.1-68: Plant A EOC 4 Core Average Axial Power Distribution



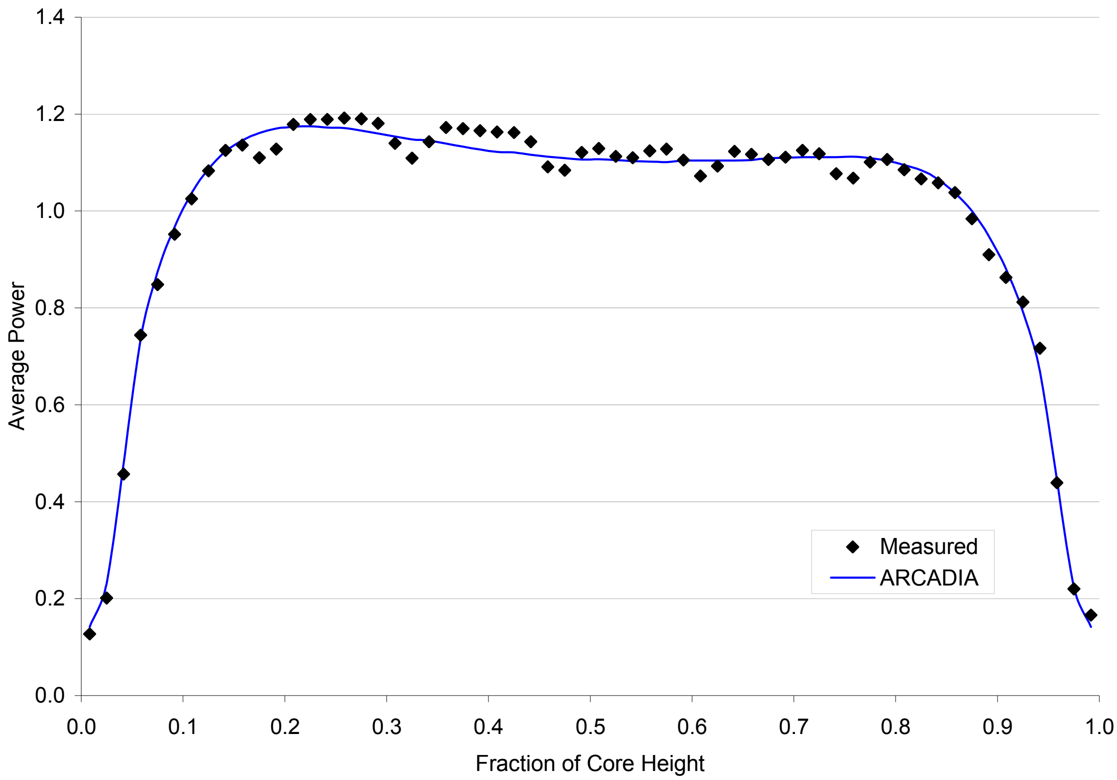
C - M Average Axial Power, RMS Difference *100 = 2.7

Figure A 10.4.1-69: Plant A BOC 5 Core Average Axial Power Distribution



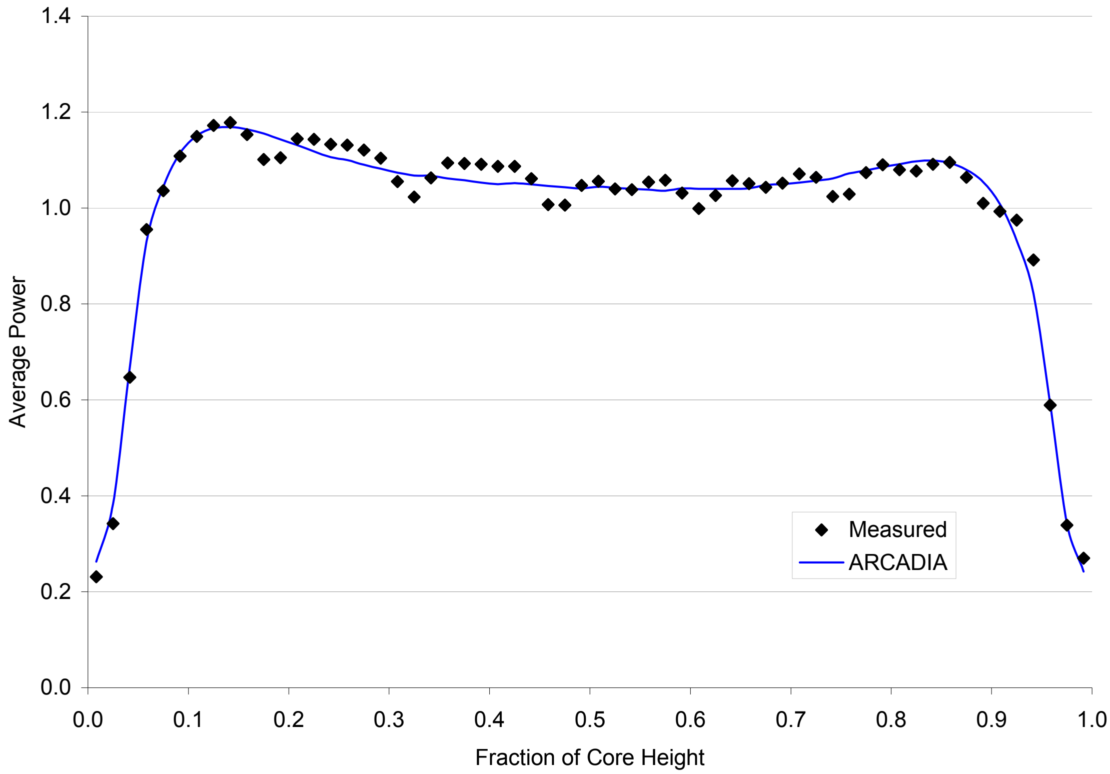
C - M Average Axial Power, RMS Difference *100 = 3.6

Figure A 10.4.1-70: Plant A MOC 5 Core Average Axial Power Distribution



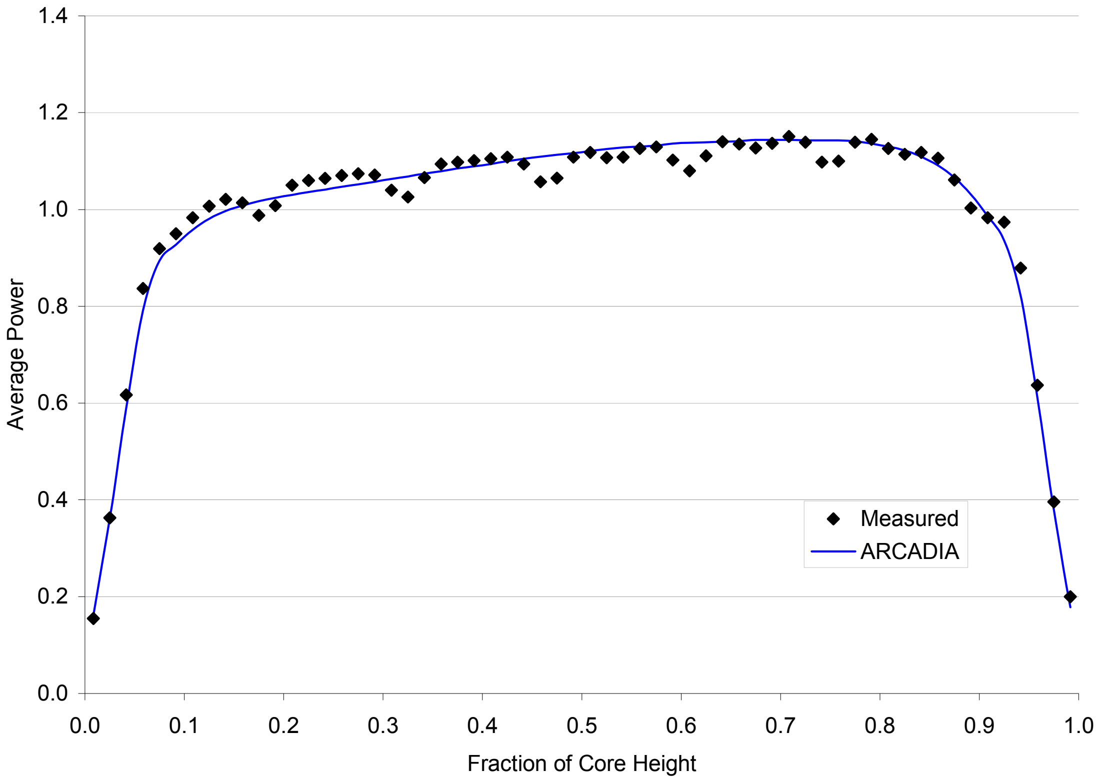
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure A 10.4.1-71: Plant A EOC 5 Core Average Axial Power Distribution



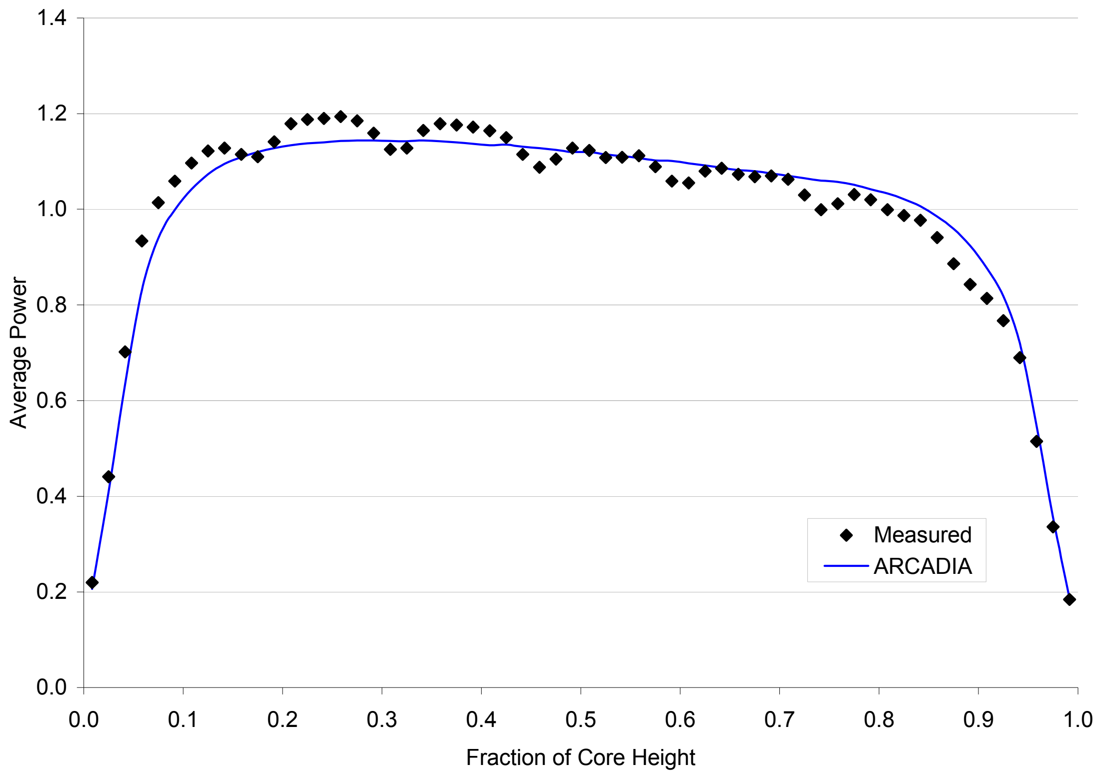
C - M Average Axial Power, RMS Difference *100 = 2.6

Figure A 10.4.1-72: Plant A BOC 6 Core Average Axial Power Distribution



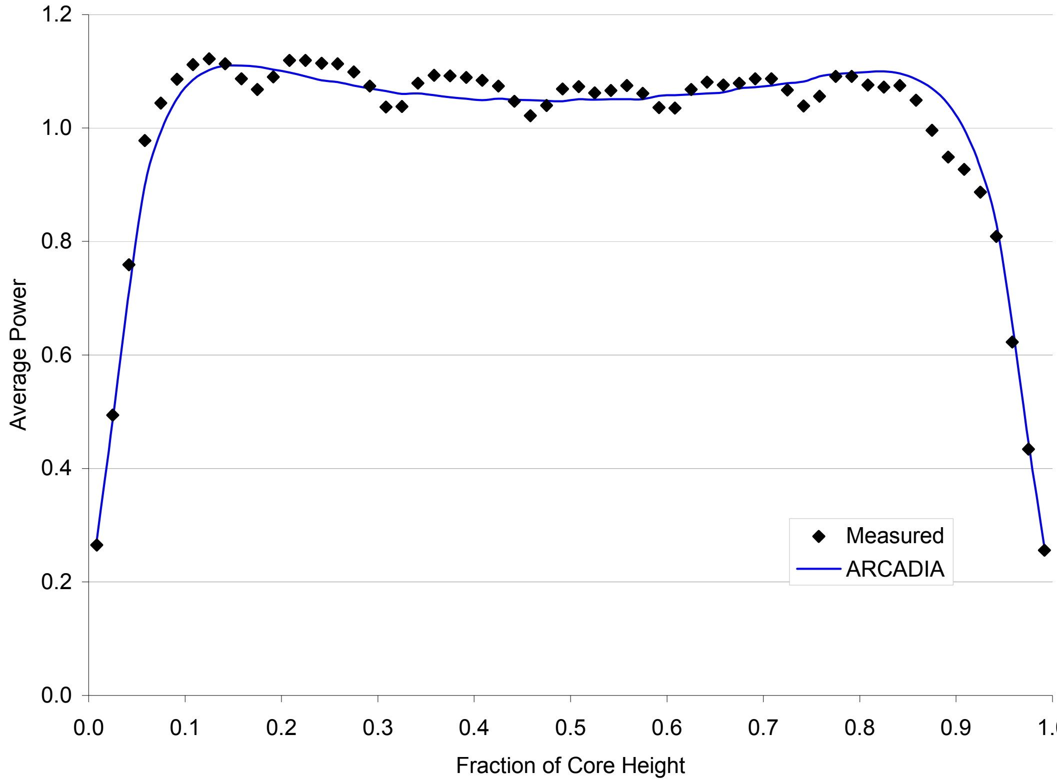
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure A 10.4.1-73: Plant A MOC 6 Core Average Axial Power Distribution



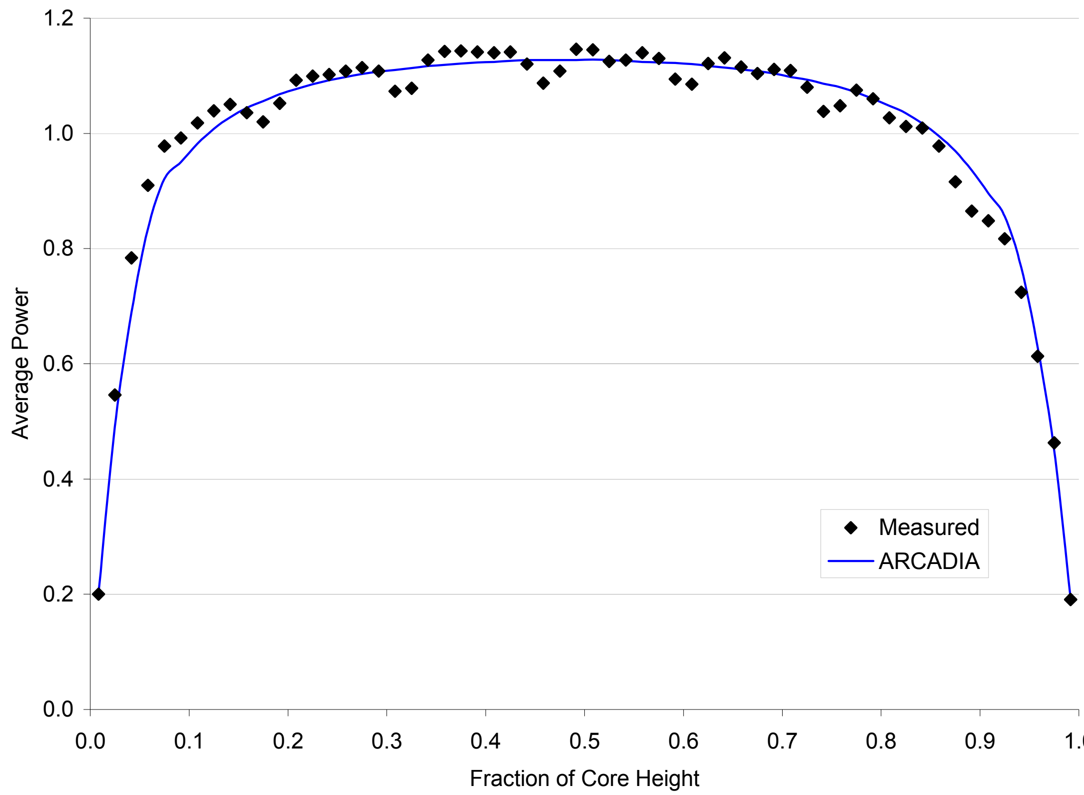
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure A 10.4.1-74: Plant A EOC 6 Core Average Axial Power Distribution



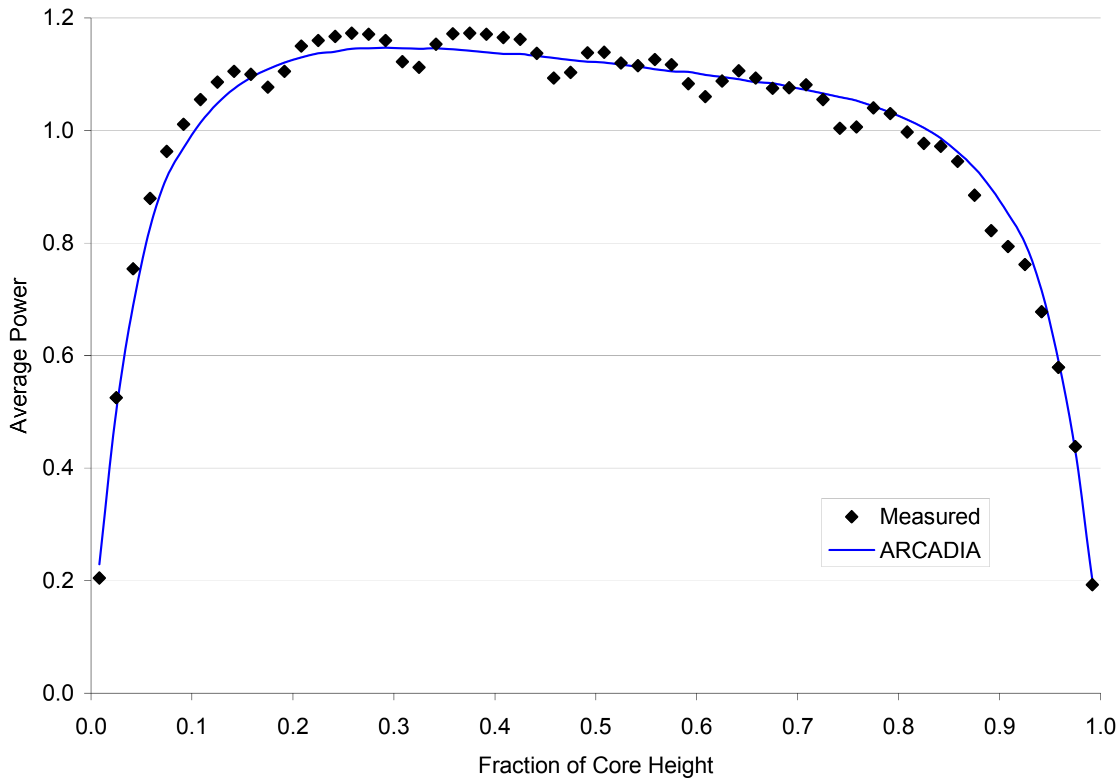
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure A 10.4.1-75: Plant A BOC 7 Core Average Axial Power Distribution



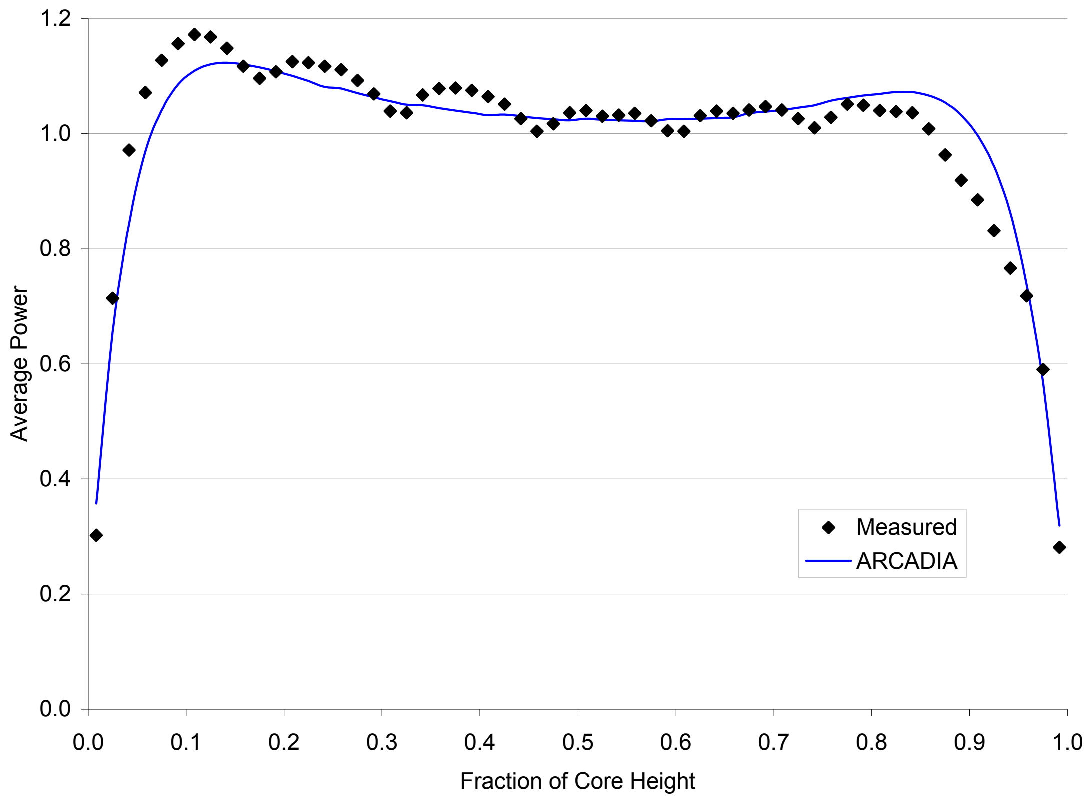
C - M Average Axial Power, RMS Difference *100 = 2.0

Figure A 10.4.1-76: Plant A MOC 7 Core Average Axial Power Distribution



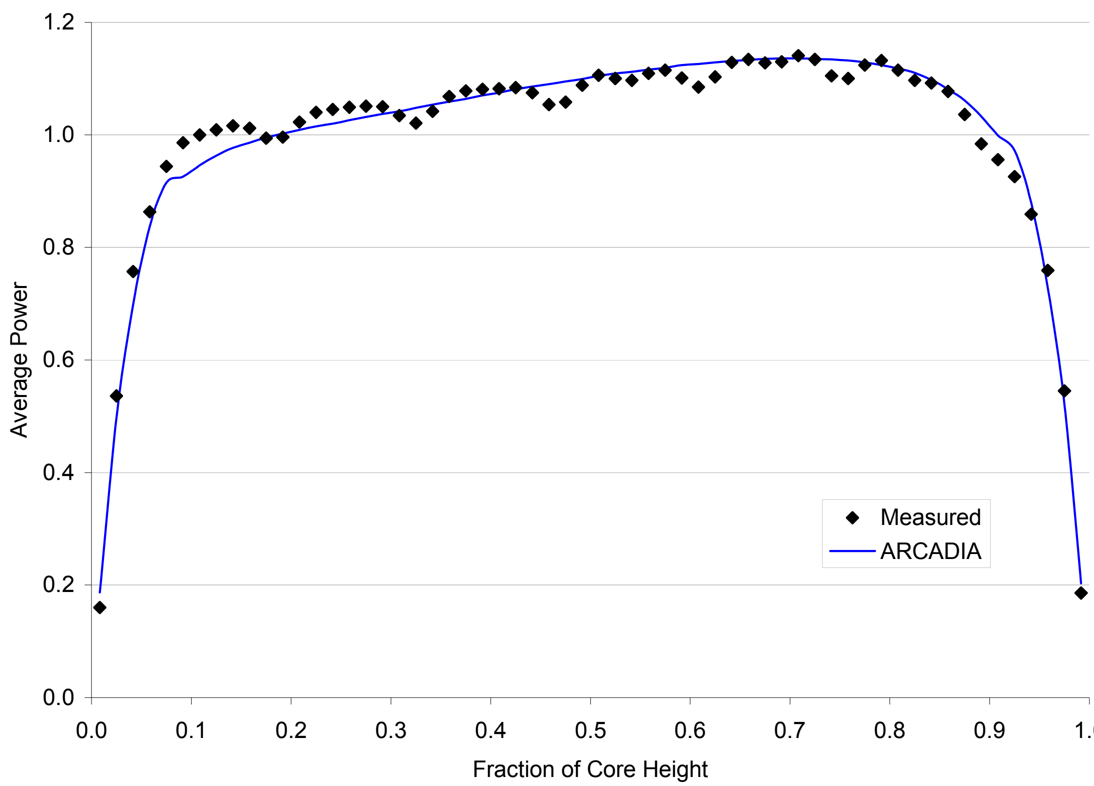
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure A 10.4.1-77: Plant A EOC 7 Core Average Axial Power Distribution



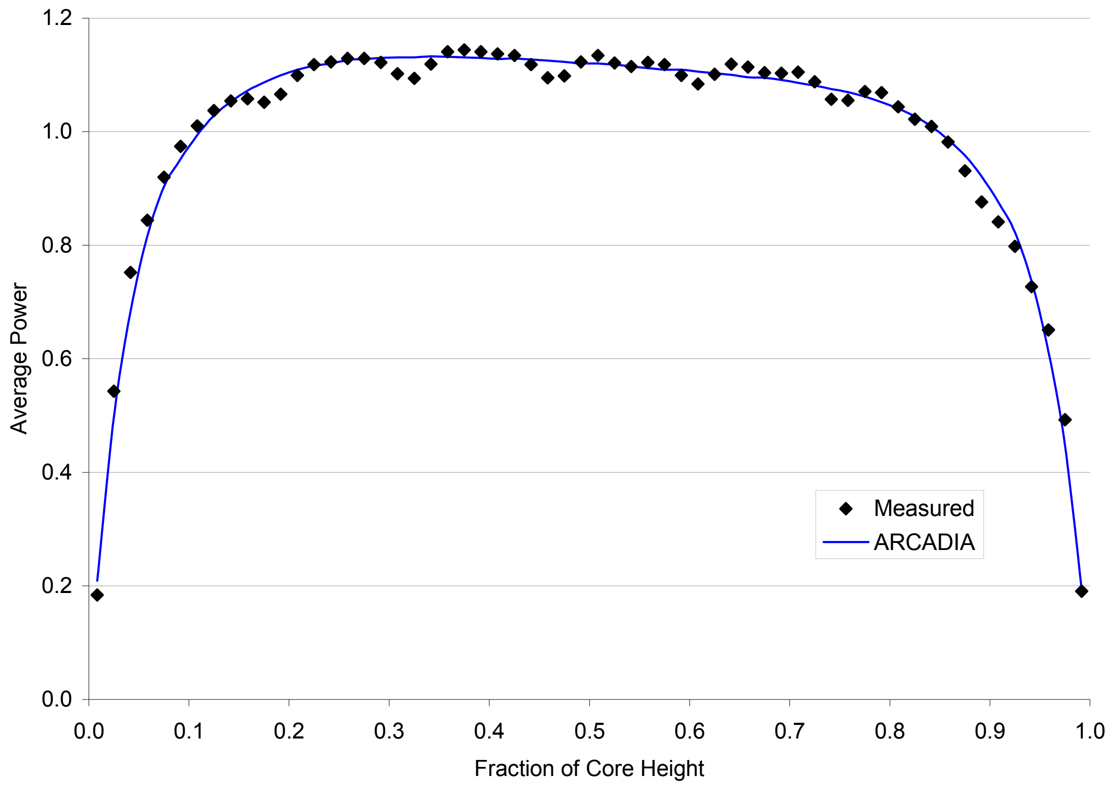
C - M Average Axial Power, RMS Difference *100 = 2.2

Figure A 10.4.1-78: Plant A BOC 8 Core Average Axial Power Distribution



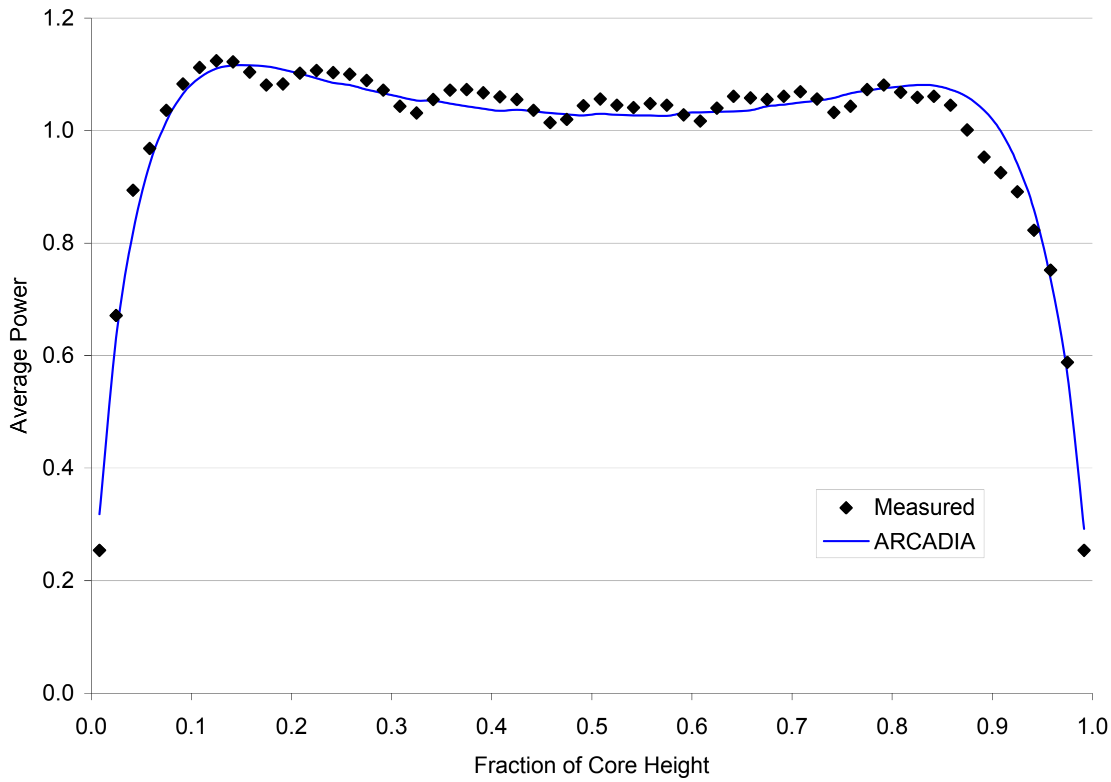
C - M Average Axial Power, RMS Difference *100 = 1.8

Figure A 10.4.1-79: Plant A MOC 8 Core Average Axial Power Distribution



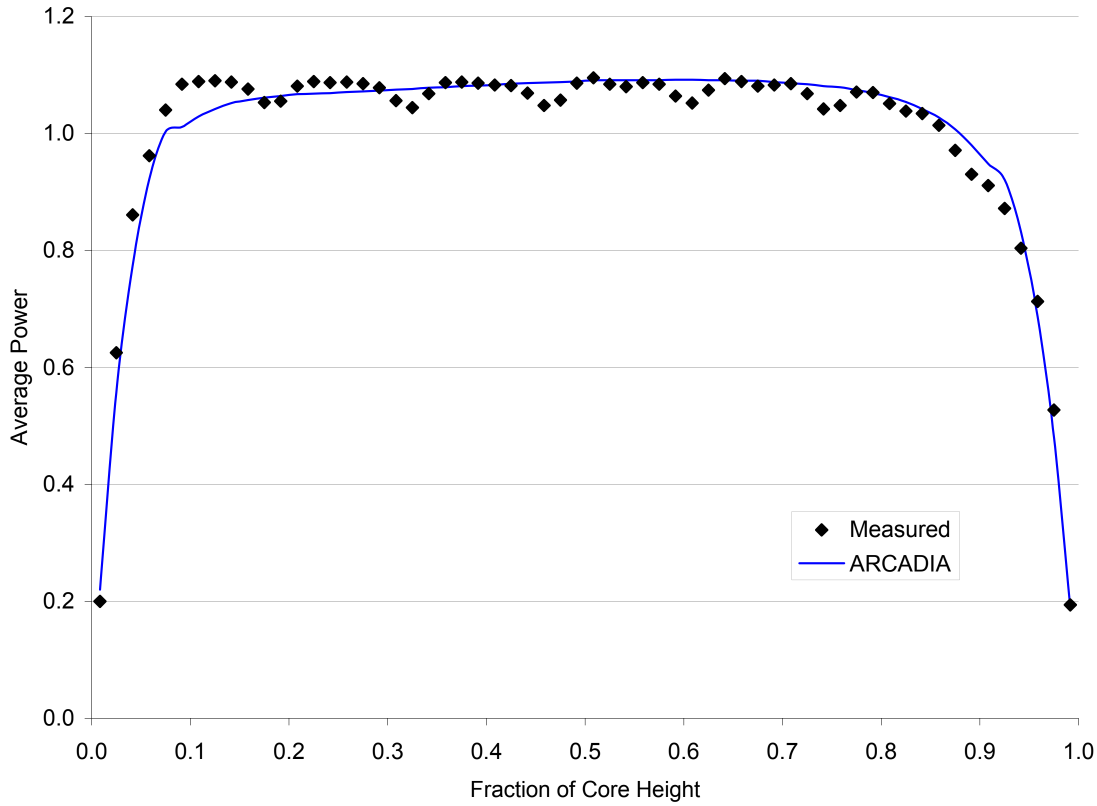
C - M Average Axial Power, RMS Difference *100 = 1.6

Figure A 10.4.1-80: Plant A EOC 8 Core Average Axial Power Distribution



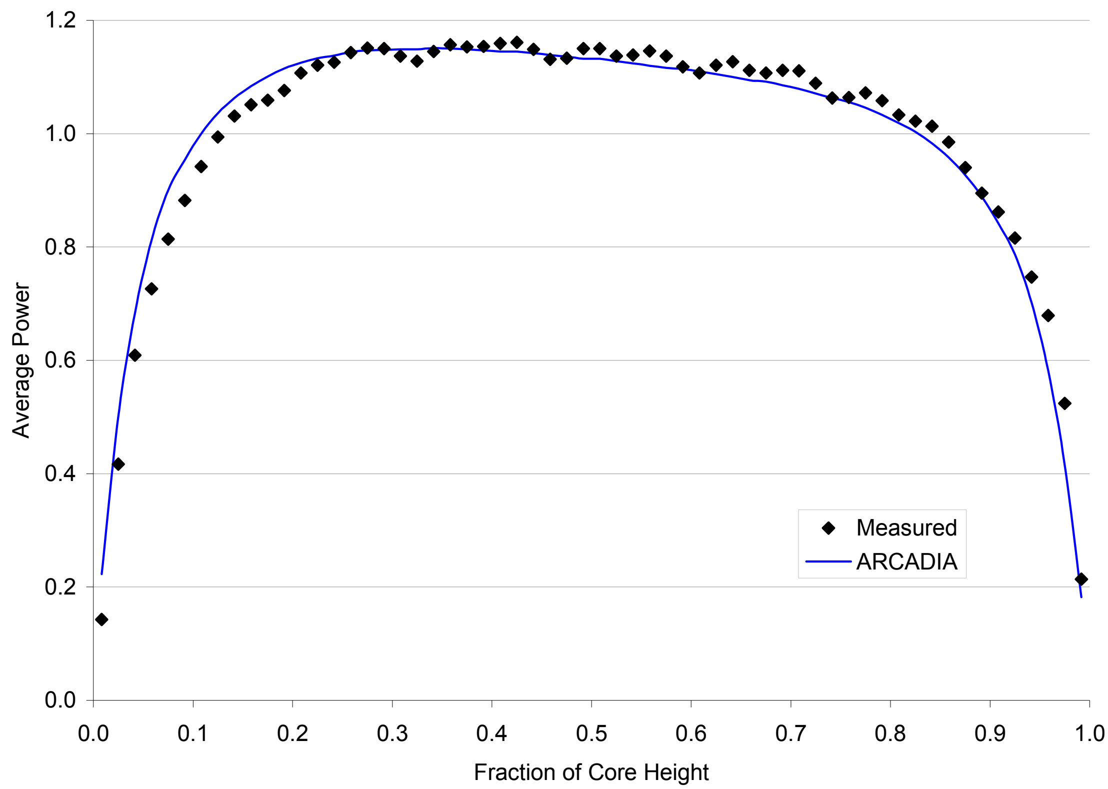
C - M Average Axial Power, RMS Difference *100 = 1.8

Figure A 10.4.1-81: Plant A BOC 9 Core Average Axial Power Distribution



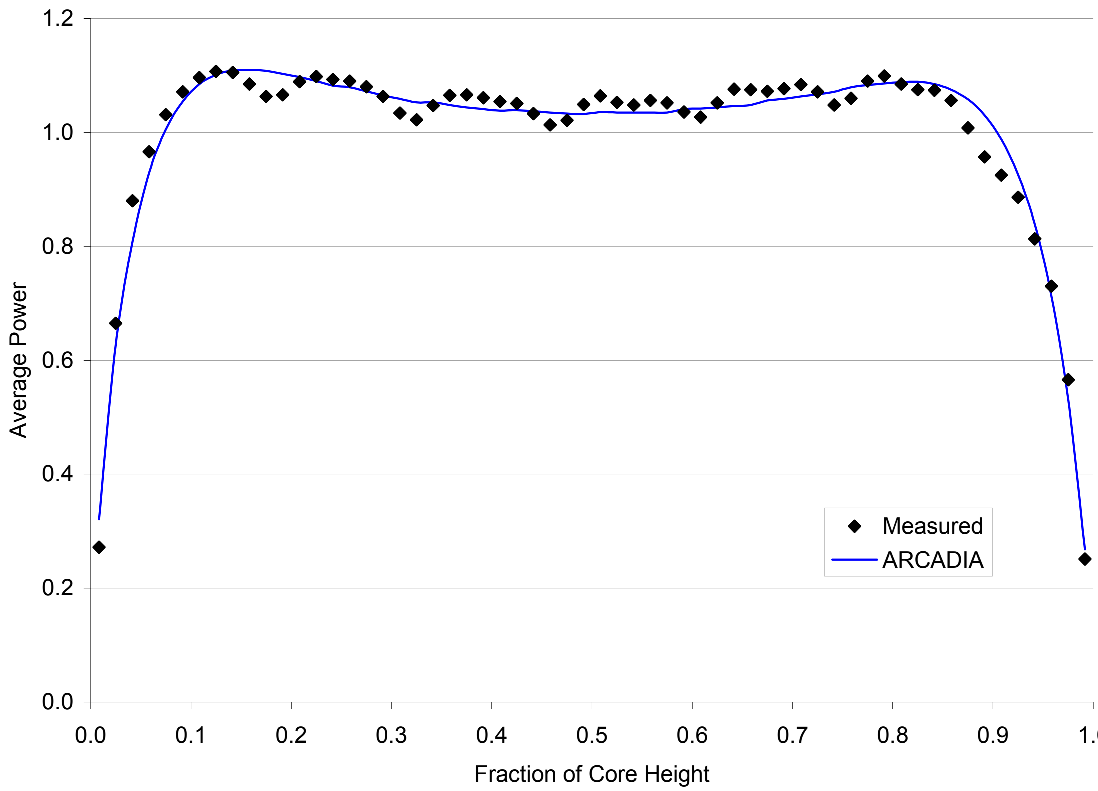
C - M Average Axial Power, RMS Difference *100 = 1.7

Figure A 10.4.1-82: Plant A MOC 9 Core Average Axial Power Distribution



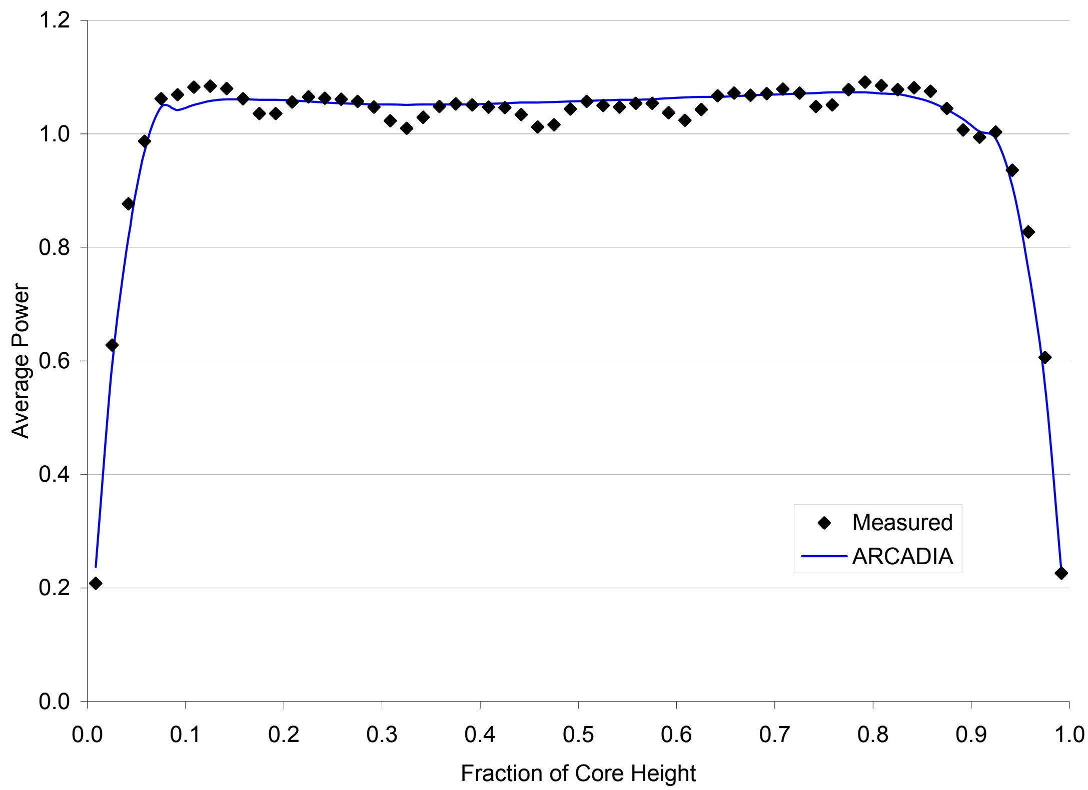
C - M Average Axial Power, RMS Difference *100 = 1.9

Figure A 10.4.1-83: Plant A EOC 9 Core Average Axial Power Distribution



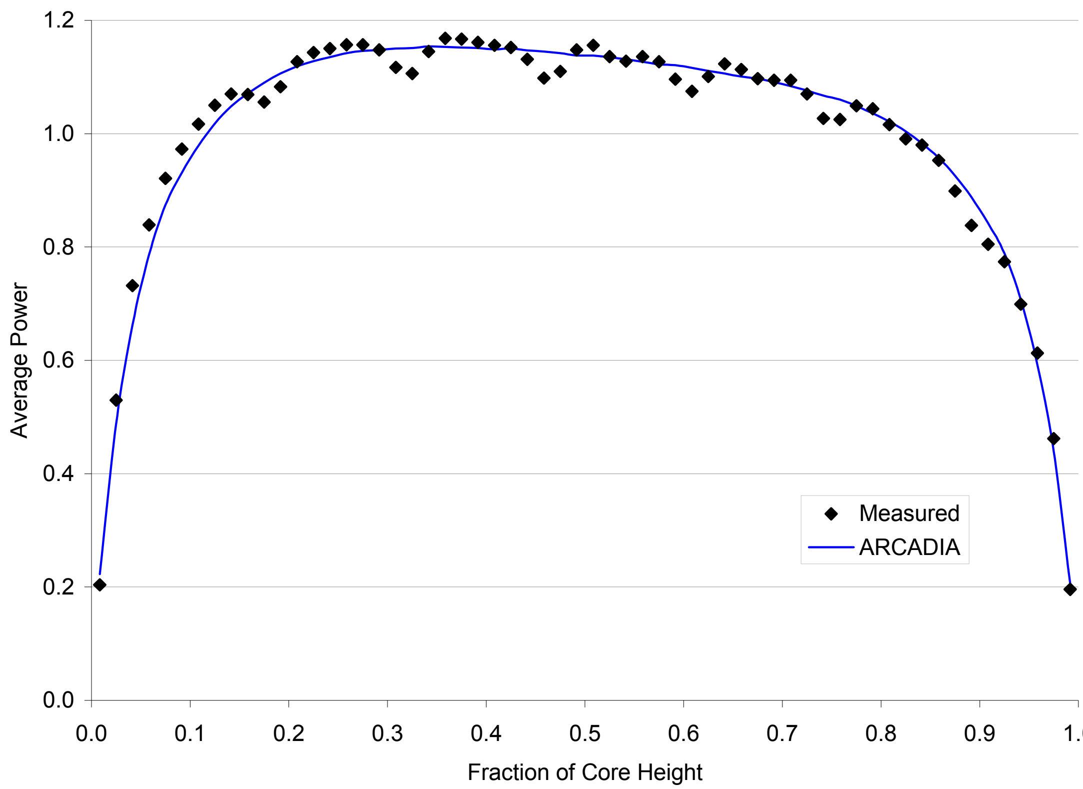
C - M Average Axial Power, RMS Difference *100 = 1.9

Figure A 10.4.1-84: Plant A BOC 10 Core Average Axial Power Distribution



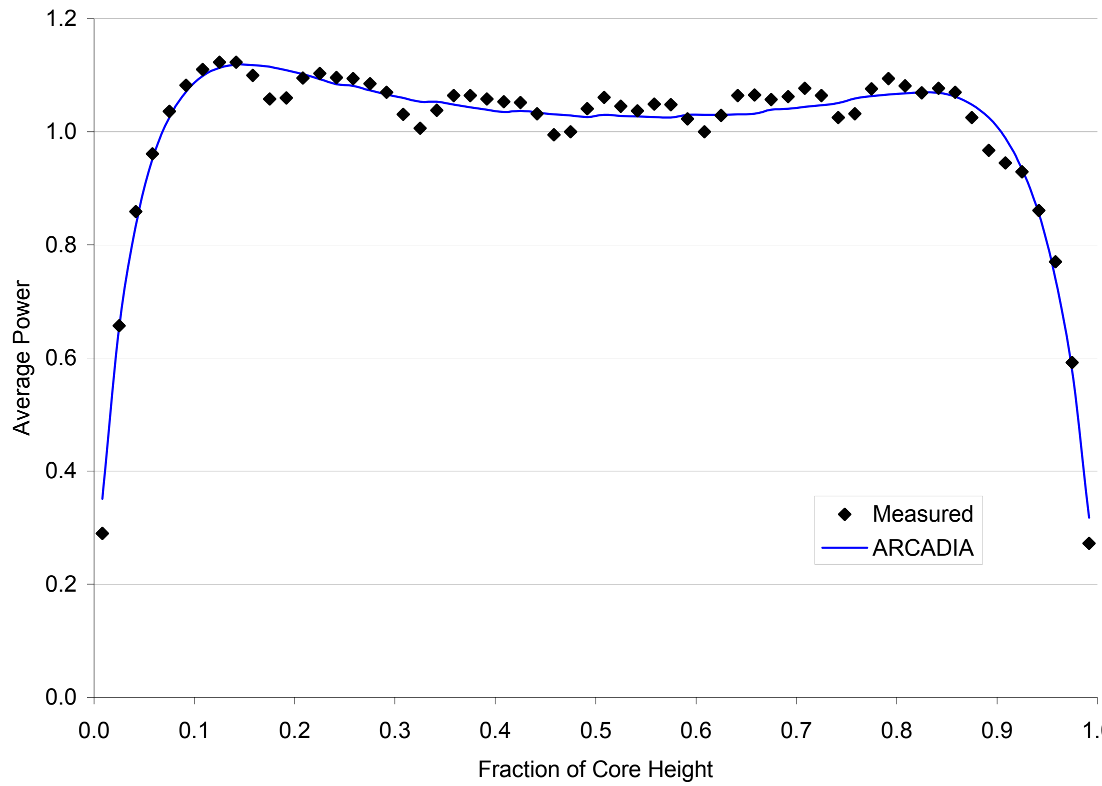
C - M Average Axial Power, RMS Difference *100 = 1.8

Figure A 10.4.1-85: Plant A MOC 10 Core Average Axial Power Distribution



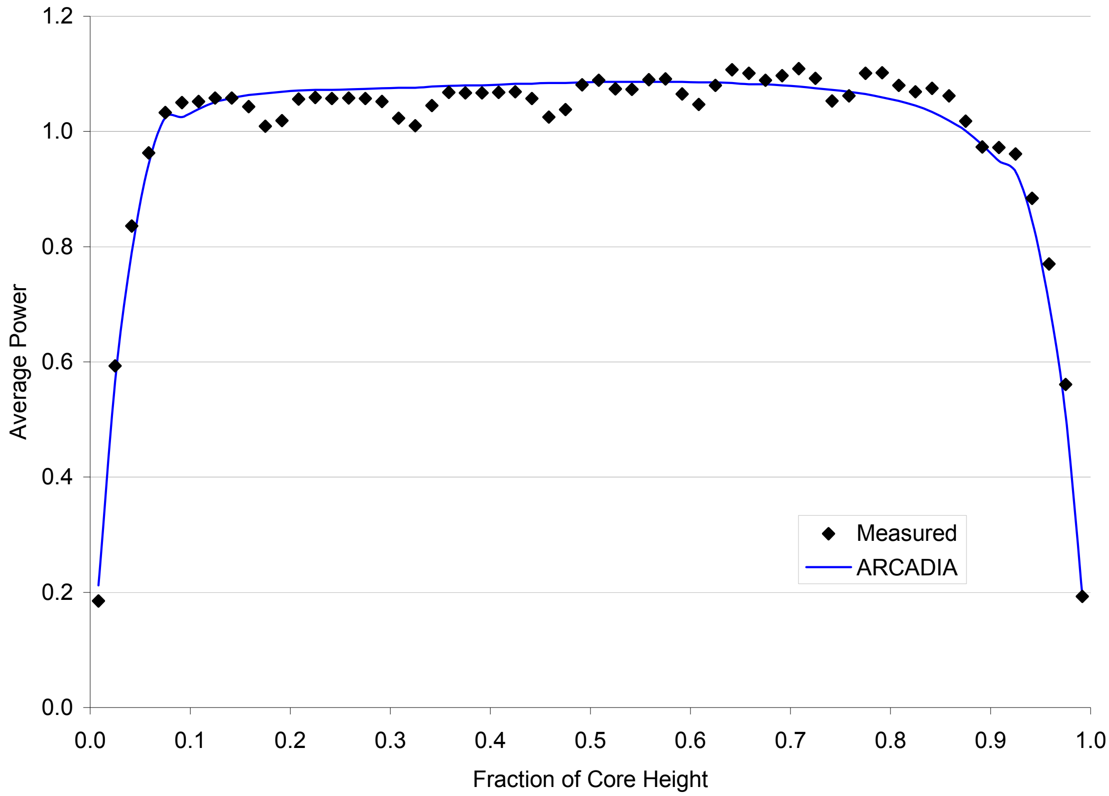
C - M Average Axial Power, RMS Difference *100 = 2.0

Figure A 10.4.1-86: Plant A EOC 10 Core Average Axial Power Distribution



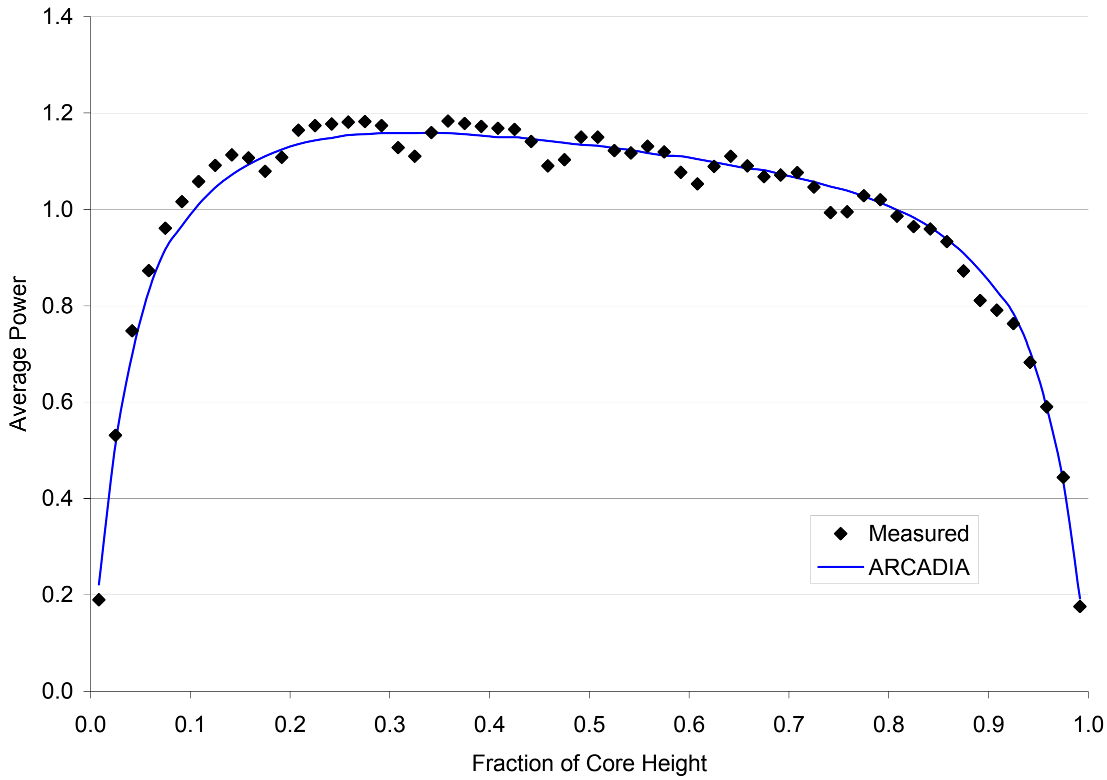
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure A 10.4.1-87: Plant A BOC 11 Core Average Axial Power Distribution



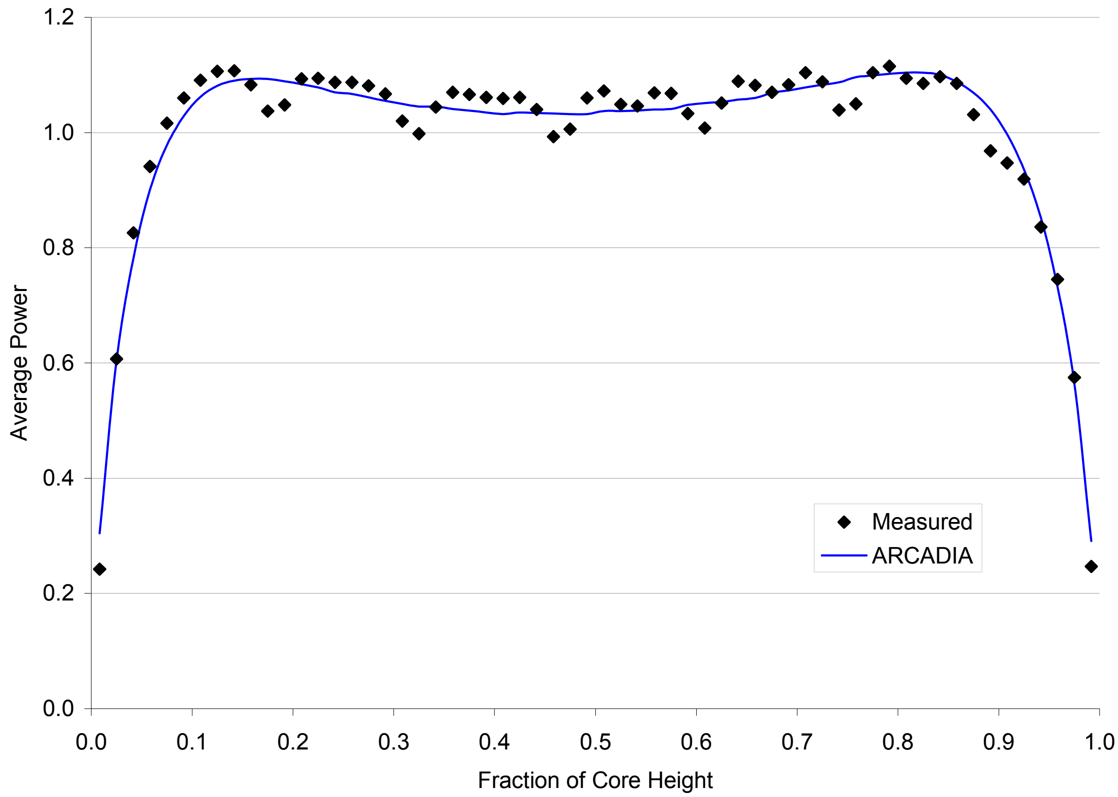
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure A 10.4.1-88: Plant A MOC 11 Core Average Axial Power Distribution



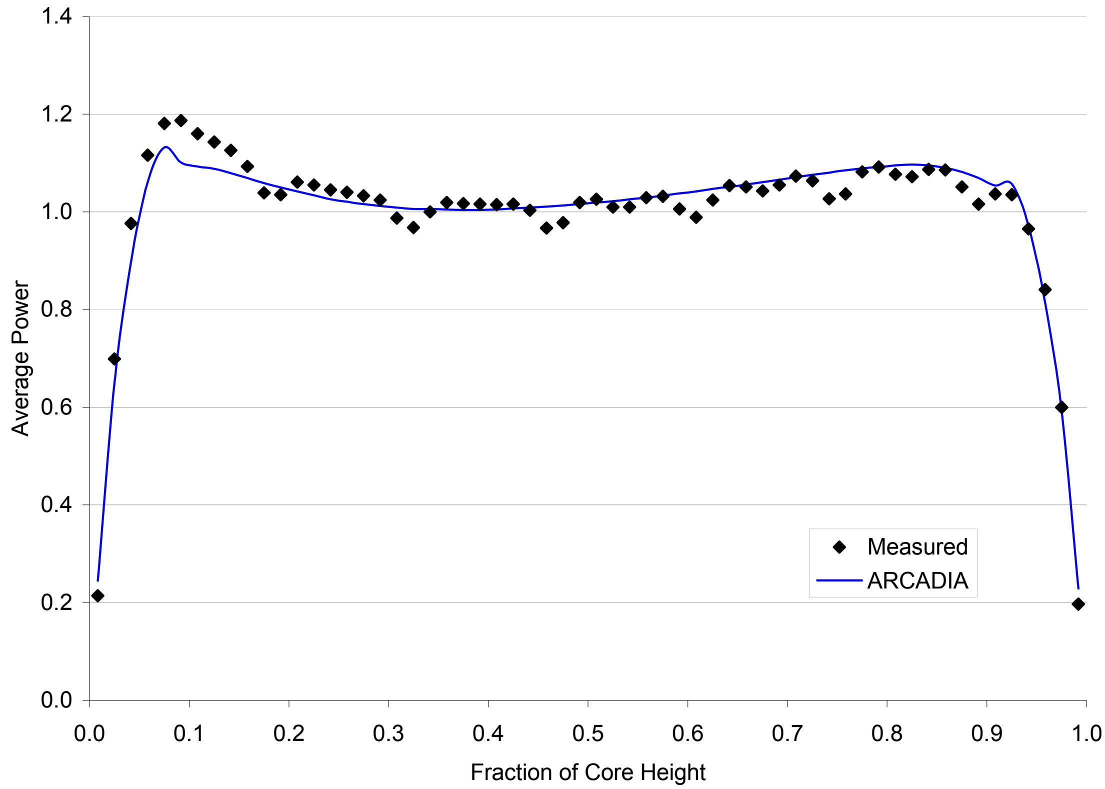
C - M Average Axial Power, RMS Difference *100 = 2.5

Figure A 10.4.1-89: Plant A EOC 11 Core Average Axial Power Distribution



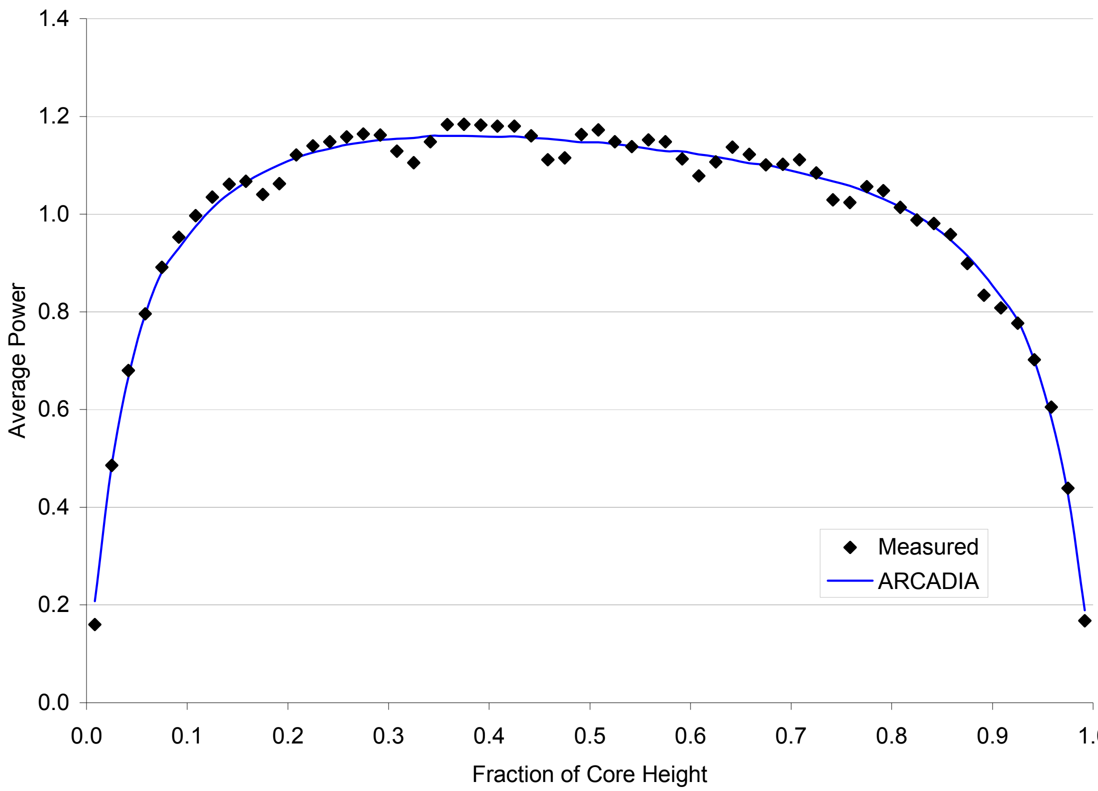
C - M Average Axial Power, RMS Difference *100 = 2.6

Figure A 10.4.1-90: Plant A BOC 12 Core Average Axial Power Distribution



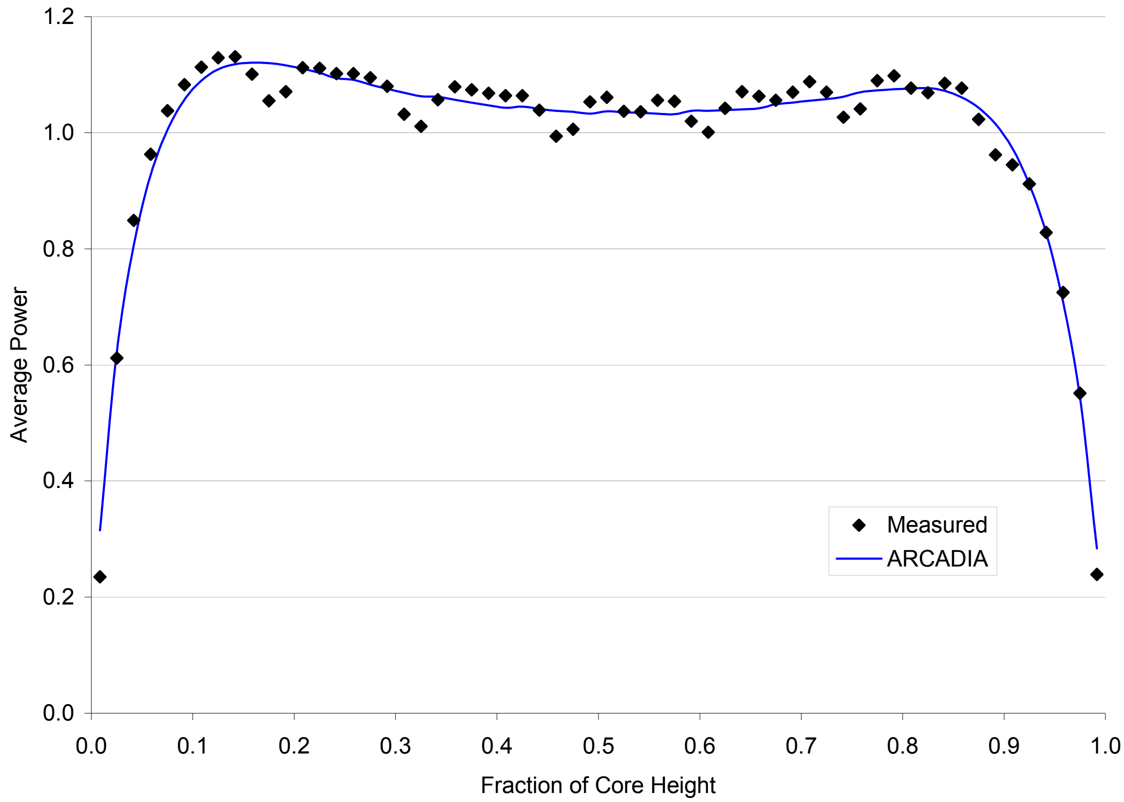
C - M Average Axial Power, RMS Difference *100 = 2.2

Figure A 10.4.1-91: Plant A MOC 12 Core Average Axial Power Distribution



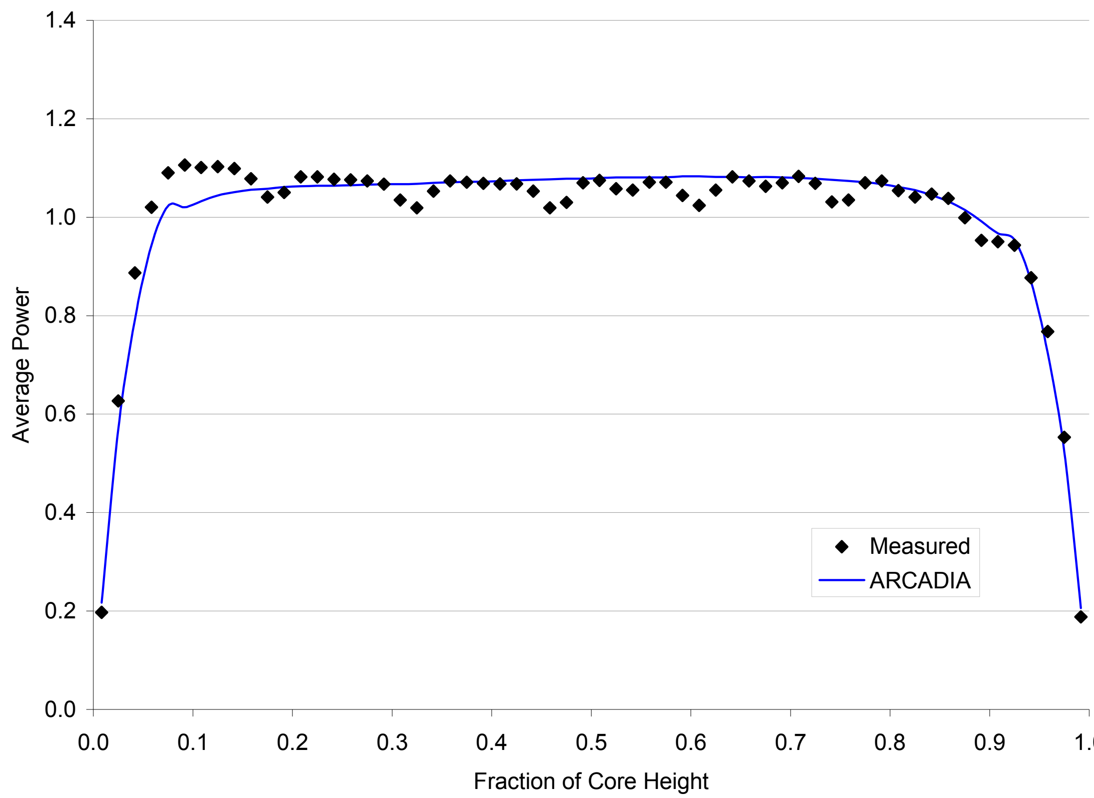
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure A 10.4.1-92: Plant A EOC 12 Core Average Axial Power Distribution



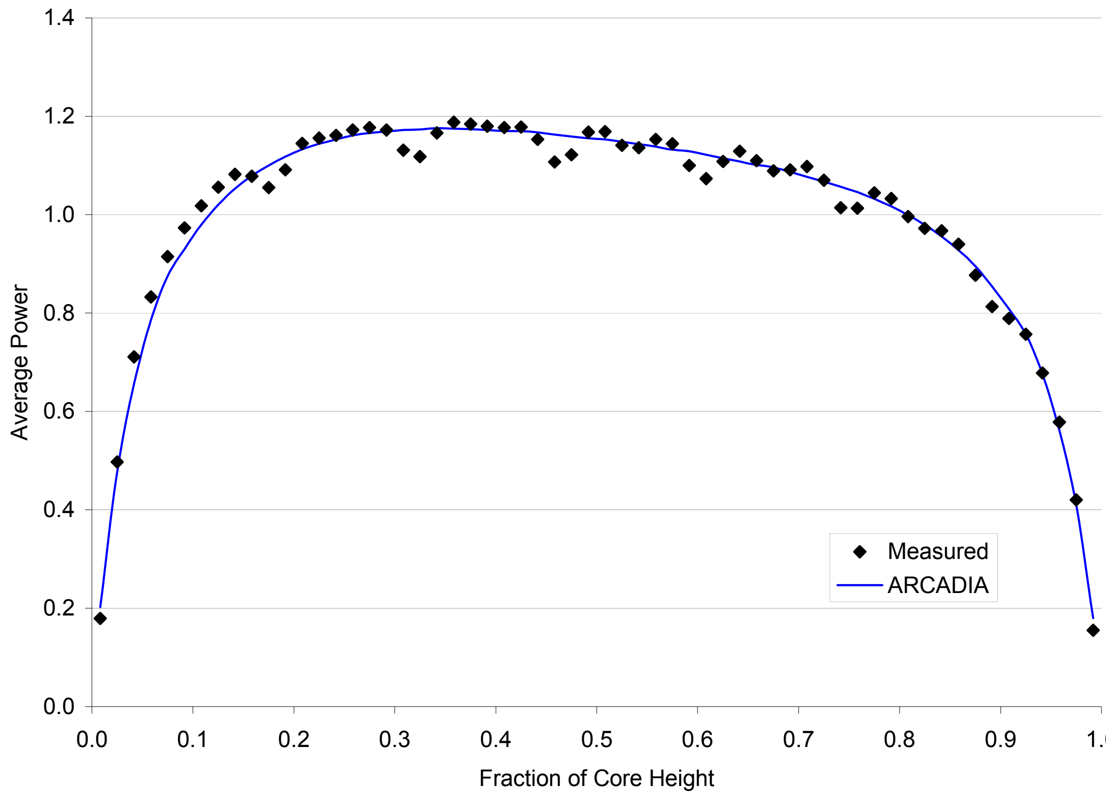
C - M Average Axial Power, RMS Difference *100 = 2.5

Figure A 10.4.1-93: Plant A BOC 13 Core Average Axial Power Distribution



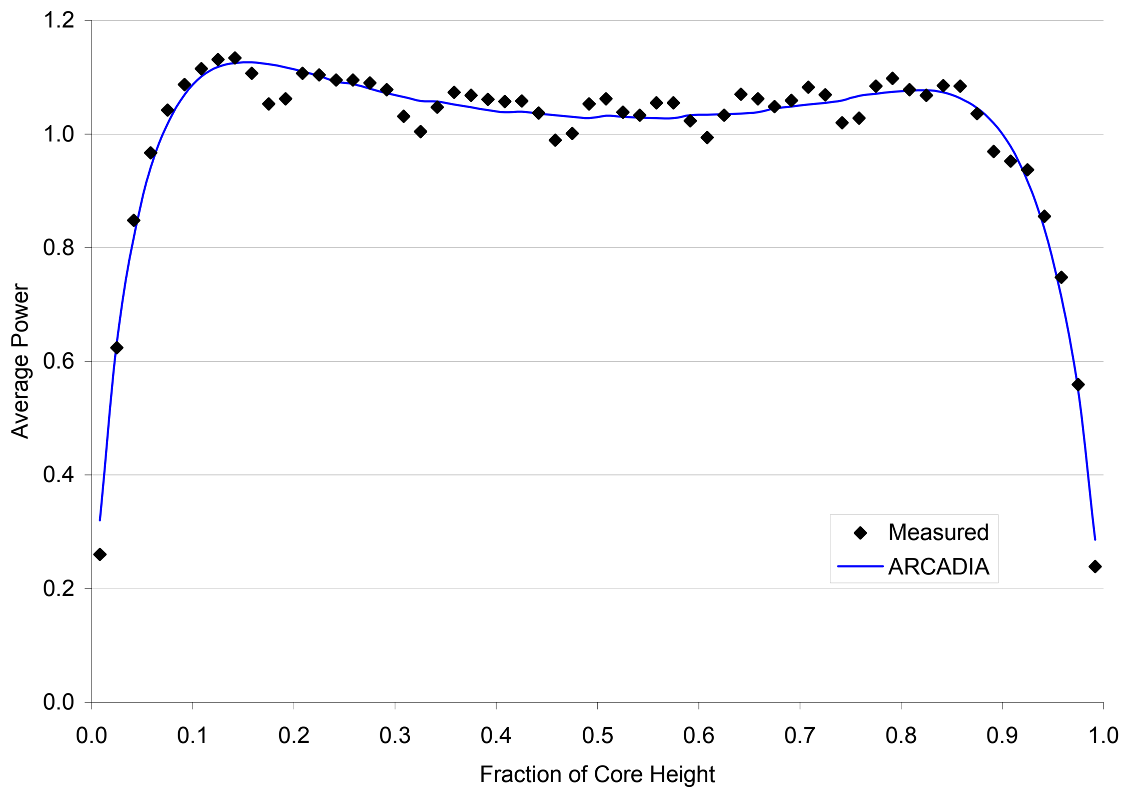
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure A 10.4.1-94: Plant A MOC 13 Core Average Axial Power Distribution



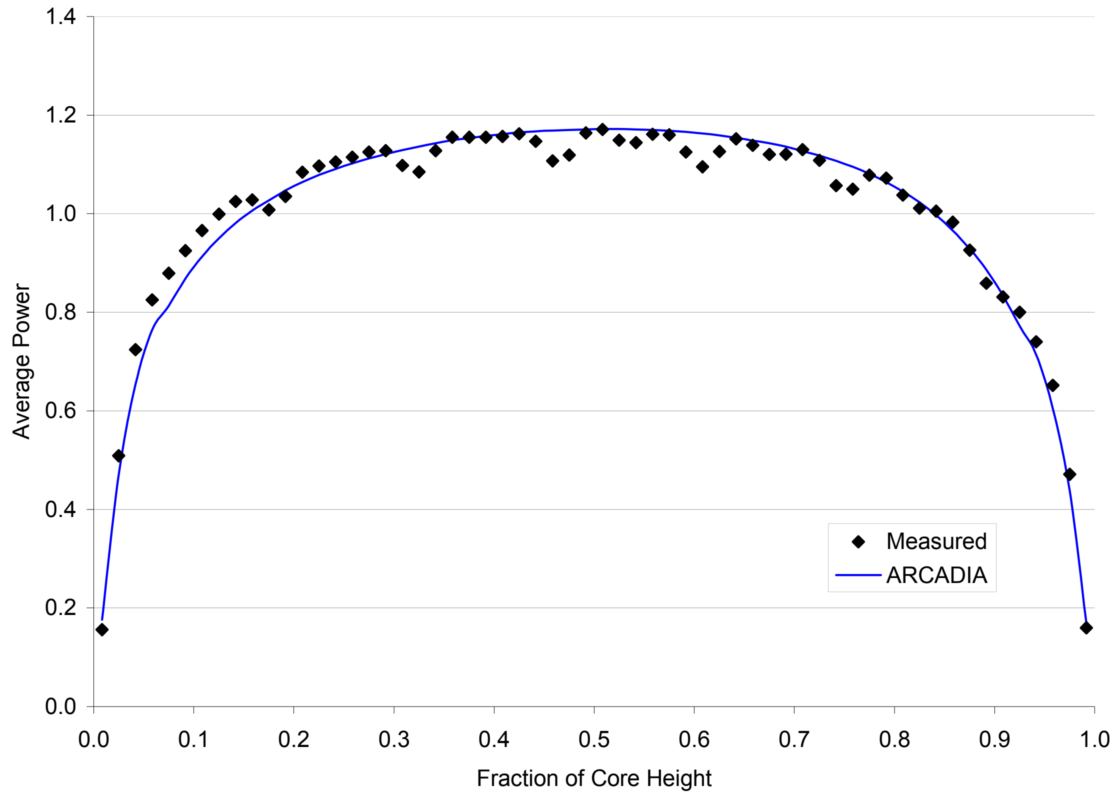
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure A 10.4.1-95: Plant A EOC 13 Core Average Axial Power Distribution



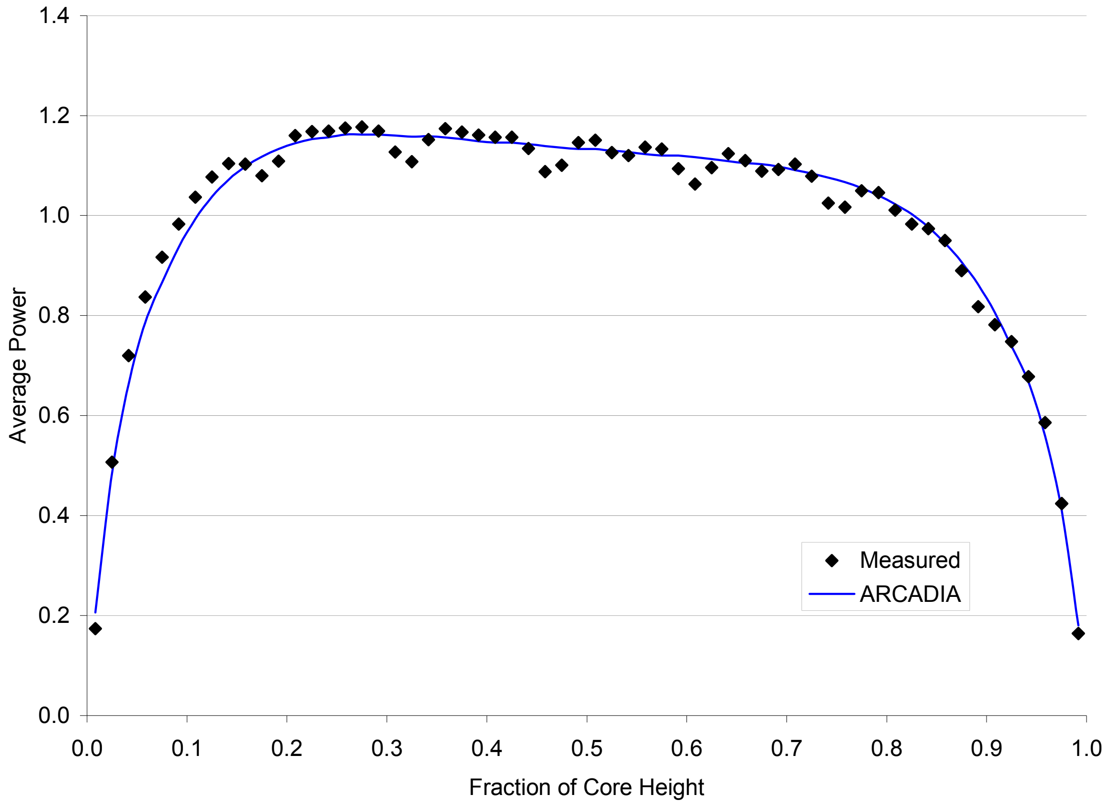
C - M Average Axial Power, RMS Difference *100 = 2.6

Figure A 10.4.1-96: Plant A BOC 14 Core Average Axial Power Distribution



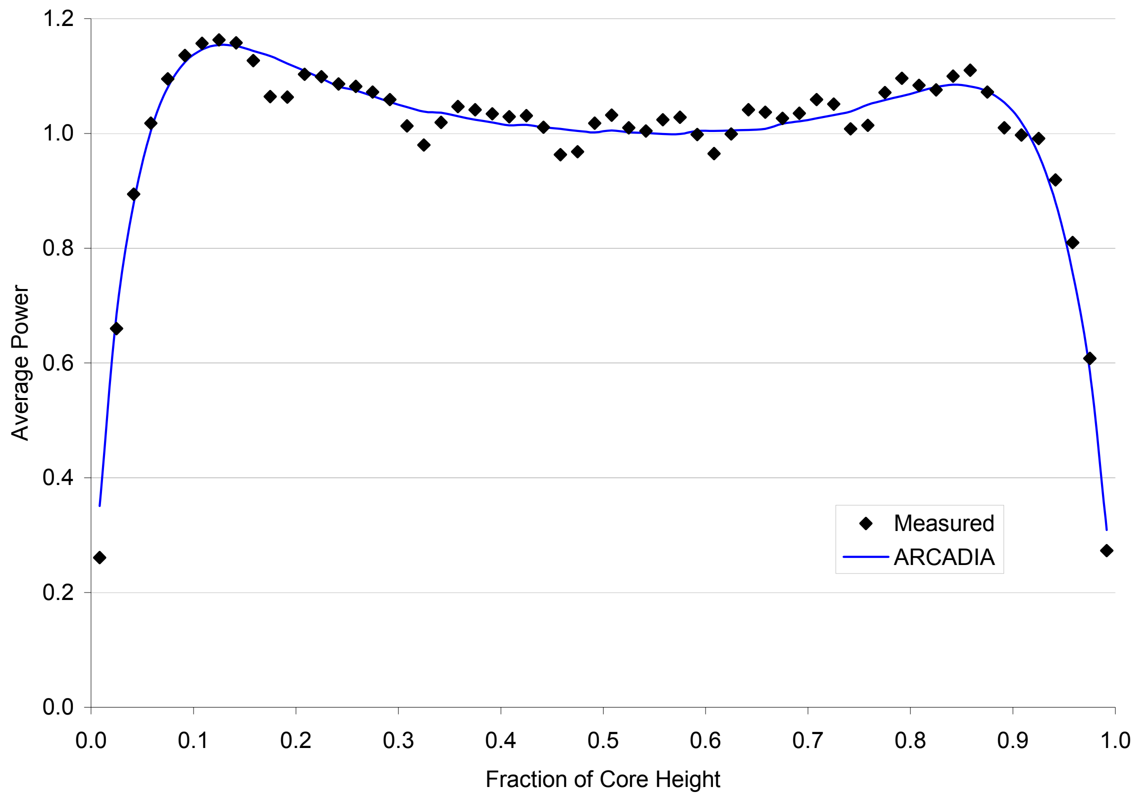
C - M Average Axial Power, RMS Difference *100 = 2.6

Figure A 10.4.1-97: Plant A MOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 2.3

Figure A 10.4.1-98: Plant A EOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 2.7

Appendix B

Table B 10.3.2-1: Plant B Hot Zero Power All Rods Out Critical Boron Concentrations

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
1	1154	1141	-13

Table B 10.3.2-2: Plant B Cycle 1 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
R	1443	1432	-11	-0.7
G1	504	494	-10	-1.9
G2	910	893	-17	-1.9
N1	973	938	-35	-3.6
N2	602	595	-7	-1.2
SA	486	452	-34	-7.0
SB	1187	1177	-10	-0.9
SC	692	680	-12	-1.8
Total	6797	6660	-137	-2.0

Table B 10.3.2-3: Plant B Summary of Total Bank Worths

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/C (%)
1	6797	6660	-137	-2.0

Table B 10.3.2-4: Plant B Hot Zero Power All Rods Out Isothermal Temperature Coefficient

Cycle	Measured (pcm/ºF)	Calculated (pcm/ºF)	Difference C-M (pcm/ºF)
1	-0.13	0.61	0.74

Figure B 10.2.1-2: Plant B Fuel Assembly Guide Tube Configuration

3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	1	3	3	1	3	3	1	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	1	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	2	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	1	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	1	3	3	1	3	3	1	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1	Guide tube
2	Guide tube with instrument
3	UO_2 Rod

Figure B 10.4.2-1: Plant B Cycle 1 Critical Boron Concentration vs. Burnup

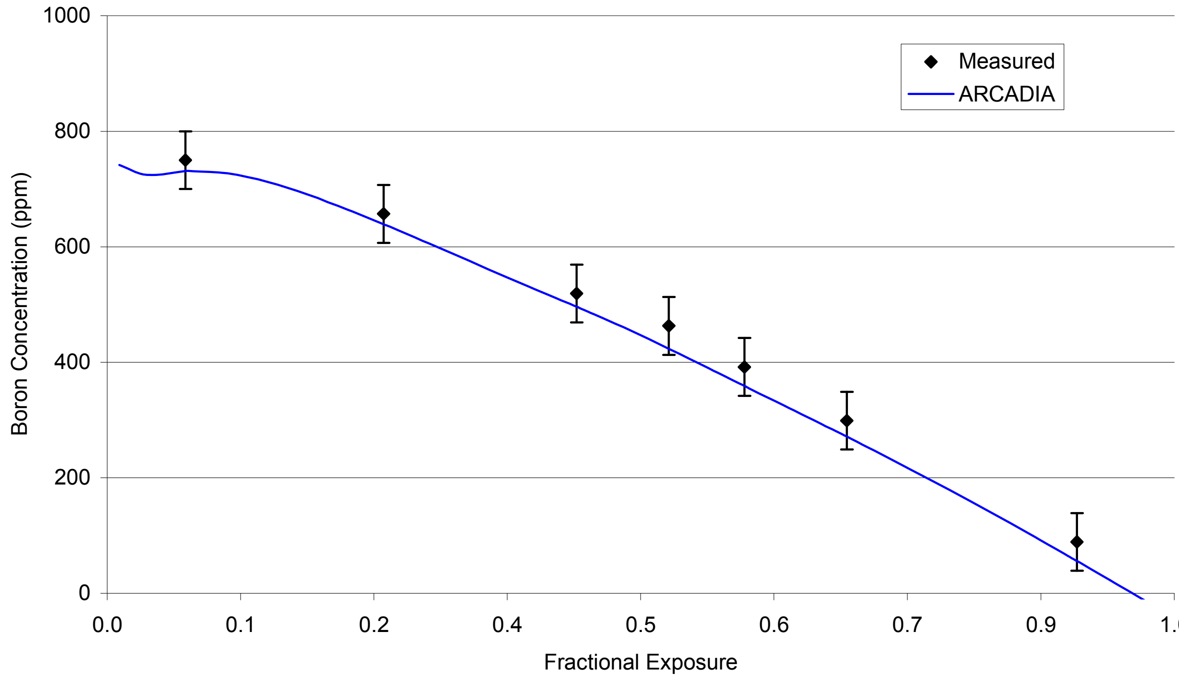


Figure B 10.4.2-2: Plant B BOC 1 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.564 0.571 -0.7	0.739 0.755 -1.6	0.564 0.573 -0.9						
2					0.570 0.571 -0.1	0.859 0.860 -0.1	0.896 0.899 -0.3	0.883 0.884 -0.1	0.896 0.905 -0.9	0.859 0.882 -2.2	0.570 0.583 -1.3	Calculated Power Measured Power Difference (C-M)*100			
3				0.610 0.634 -2.4	0.825 0.825 0.0	1.004 1.003 0.1	1.066 1.067 -0.1	1.188 1.172 1.5	1.066 1.068 -0.2	1.004 1.014 -1.0	0.825 0.840 -1.5	0.610 0.640 -3.0			
4			0.610 0.615 -0.5	0.800 0.802 -0.1	1.020 0.999 2.2	1.122 1.114 0.8	1.286 1.284 0.2	1.198 1.204 -0.6	1.286 1.290 -0.4	1.122 1.122 0.0	1.020 1.026 -0.5	0.800 0.806 -0.6	0.610 0.613 -0.3		
5		0.570 0.573 -0.3	0.825 0.836 -1.0	1.020 1.019 0.1	1.131 1.125 0.6	1.307 1.298 0.9	1.214 1.206 0.8	1.202 1.206 -0.3	1.214 1.220 -0.6	1.307 1.314 -0.6	1.131 1.130 0.1	1.020 1.007 1.3	0.825 0.827 -0.2	0.570 0.587 -1.7	
6		0.859 0.856 0.3	1.004 0.999 0.5	1.122 1.111 1.1	1.307 1.284 2.3	1.200 1.187 1.2	1.247 1.246 0.2	1.166 1.175 -0.8	1.247 1.257 -1.0	1.200 1.217 -1.7	1.307 1.309 -0.2	1.122 1.115 0.7	1.004 1.004 0.0	0.859 0.870 -1.0	
7	0.564 0.564 0.0	0.896 0.888 0.8	1.066 1.050 1.6	1.286 1.270 1.6	1.214 1.200 1.5	1.247 1.240 0.7	1.149 1.154 -0.5	1.137 1.142 -0.5	1.149 1.154 -0.6	1.247 1.252 -0.5	1.214 1.210 0.4	1.286 1.269 1.6	1.066 1.060 0.6	0.896 0.907 -1.1	0.564 0.573 -0.9
8	0.739 0.746 -0.7	0.883 0.873 1.0	1.188 1.163 2.4	1.198 1.182 1.6	1.202 1.187 1.5	1.166 1.160 0.7	1.137 1.136 0.1	1.098 1.100 -0.1	1.137 1.139 -0.2	1.166 1.165 0.1	1.202 1.194 0.8	1.198 1.184 1.3	1.188 1.167 2.0	0.883 0.888 -0.5	0.739 0.753 -1.4
9	0.564 0.564 0.1	0.896 0.886 0.9	1.066 1.051 1.5	1.286 1.276 1.0	1.214 1.215 -0.1	1.247 1.242 0.5	1.149 1.144 0.5	1.137 1.136 0.1	1.149 1.153 -0.4	1.247 1.223 2.4	1.214 1.201 1.4	1.286 1.274 1.2	1.066 1.061 0.4	0.896 0.907 -1.1	0.564 0.586 -2.2
10		0.859 0.849 1.0	1.004 0.986 1.8	1.122 1.115 0.7	1.307 1.304 0.3	1.200 1.191 0.8	1.247 1.233 1.4	1.166 1.161 0.5	1.247 1.241 0.7	1.200 1.182 1.7	1.307 1.294 1.3	1.122 1.111 1.1	1.004 1.007 -0.3	0.859 0.876 -1.7	
11		0.570 0.568 0.2	0.825 0.828 -0.3	1.020 1.023 -0.2	1.131 1.133 -0.2	1.307 1.304 0.3	1.214 1.208 0.7	1.202 1.202 0.0	1.214 1.207 0.8	1.307 1.289 1.8	1.131 1.125 0.6	1.020 1.017 0.3	0.825 0.834 -0.9	0.570 0.579 -0.9	
12			0.610 0.638 -2.8	0.800 0.812 -1.1	1.020 1.027 -0.7	1.122 1.122 -0.1	1.286 1.276 1.0	1.198 1.191 0.7	1.286 1.278 0.8	1.122 1.112 1.0	1.020 1.014 0.6	0.800 0.797 0.4	0.610 0.635 -2.4		
13				0.610 0.619 -0.9	0.825 0.838 -1.3	1.004 1.012 -0.8	1.066 1.066 -0.1	1.188 1.176 1.2	1.066 1.062 0.4	1.004 0.995 0.9	0.825 0.820 0.5	0.610 0.607 0.3			
14					0.570 0.595 -2.5	0.859 0.877 -1.7	0.896 0.912 -1.6	0.883 0.890 -0.7	0.896 0.910 -1.4	0.859 0.861 -0.2	0.570 0.569 0.1				
15							0.564 0.599 -3.5	0.739 0.759 -2.0	0.564 0.576 -1.2						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.1

Figure B 10.4.2-3: Plant B MOC 1 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.583 0.586 -0.3	0.733 0.742 -0.9	0.583 0.589 -0.6						
2					0.607 0.604 0.3	0.871 0.869 0.2	0.959 0.958 0.0	0.899 0.898 0.1	0.959 0.966 -0.7	0.871 0.889 -1.8	0.607 0.619 -1.2				
3				0.653 0.664 -1.1	0.923 0.916 0.6	1.039 1.035 0.4	1.033 1.034 -0.1	1.138 1.123 1.5	1.033 1.037 -0.4	1.039 1.052 -1.3	0.923 0.939 -1.6	0.653 0.677 -2.4			
4			0.653 0.649 0.4	0.839 0.833 0.6	1.052 1.026 2.6	1.069 1.062 0.6	1.201 1.205 -0.4	1.119 1.132 -1.2	1.201 1.212 -1.2	1.069 1.080 -1.2	1.052 1.063 -1.1	0.839 0.846 -0.7	0.653 0.656 -0.3		
5		0.607 0.603 0.4	0.923 0.917 0.6	1.052 1.046 0.6	1.067 1.067 0.0	1.206 1.205 0.1	1.140 1.148 -0.7	1.250 1.261 -1.1	1.140 1.154 -1.4	1.206 1.223 -1.7	1.067 1.074 -0.7	1.052 1.039 1.2	0.923 0.924 -0.1	0.607 0.622 -1.6	
6		0.871 0.865 0.6	1.039 1.032 0.7	1.069 1.059 1.0	1.206 1.190 1.6	1.119 1.112 0.7	1.235 1.238 -0.3	1.171 1.182 -1.1	1.235 1.252 -1.7	1.119 1.146 -2.8	1.206 1.217 -1.1	1.069 1.068 0.1	1.039 1.040 -0.1	0.871 0.877 -0.6	
7	0.583 0.581 0.2	0.959 0.951 0.7	1.033 1.029 0.4	1.201 1.188 1.2	1.140 1.125 1.5	1.235 1.226 0.9	1.180 1.179 0.1	1.294 1.299 -0.5	1.180 1.190 -1.0	1.235 1.250 -1.4	1.140 1.146 -0.6	1.201 1.196 0.5	1.033 1.030 0.3	0.959 0.961 -0.2	0.583 0.587 -0.3
8	0.733 0.733 0.1	0.899 0.888 1.1	1.138 1.116 2.2	1.119 1.103 1.6	1.250 1.219 3.1	1.171 1.160 1.1	1.294 1.288 0.6	1.207 1.208 -0.2	1.294 1.301 -0.7	1.171 1.181 -1.1	1.250 1.252 -0.2	1.119 1.116 0.4	1.138 1.125 1.3	0.899 0.898 0.1	0.733 0.741 -0.7
9	0.583 0.579 0.4	0.959 0.947 1.2	1.033 1.020 1.3	1.201 1.194 0.7	1.140 1.148 -0.8	1.235 1.231 0.4	1.180 1.173 0.7	1.294 1.291 0.3	1.180 1.189 -0.9	1.235 1.219 1.7	1.140 1.137 0.4	1.201 1.198 0.2	1.033 1.031 0.2	0.959 0.963 -0.5	0.583 0.600 -1.7
10		0.871 0.860 1.1	1.039 1.021 1.7	1.069 1.064 0.5	1.206 1.207 -0.1	1.119 1.112 0.7	1.235 1.217 1.8	1.171 1.161 1.0	1.235 1.231 0.4	1.119 1.112 0.7	1.206 1.206 0.0	1.069 1.069 -0.1	1.039 1.041 -0.2	0.871 0.876 -0.5	
11		0.607 0.603 0.4	0.923 0.922 0.1	1.052 1.054 -0.2	1.067 1.074 -0.7	1.206 1.204 0.2	1.140 1.130 1.0	1.250 1.231 1.9	1.140 1.132 0.8	1.206 1.202 0.3	1.067 1.076 -0.9	1.052 1.054 -0.2	0.923 0.928 -0.5	0.607 0.610 -0.4	
12			0.653 0.671 -1.8	0.839 0.848 -0.8	1.052 1.058 -0.6	1.069 1.070 -0.1	1.201 1.195 0.5	1.119 1.110 0.9	1.201 1.192 0.9	1.069 1.061 0.8	1.052 1.047 0.5	0.839 0.832 0.7	0.653 0.667 -1.4		
13				0.653 0.659 -0.6	0.923 0.931 -0.8	1.039 1.044 -0.5	1.033 1.034 -0.1	1.138 1.129 0.9	1.033 1.025 0.8	1.039 1.021 1.8	0.923 0.913 1.0	0.653 0.647 0.6			
14					0.607 0.620 -1.3	0.871 0.881 -1.0	0.959 0.969 -1.1	0.899 0.901 -0.3	0.959 0.960 -0.1	0.871 0.864 0.7	0.607 0.601 0.6				
15							0.583 0.610 -2.7	0.733 0.746 -1.3	0.583 0.588 -0.5						

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

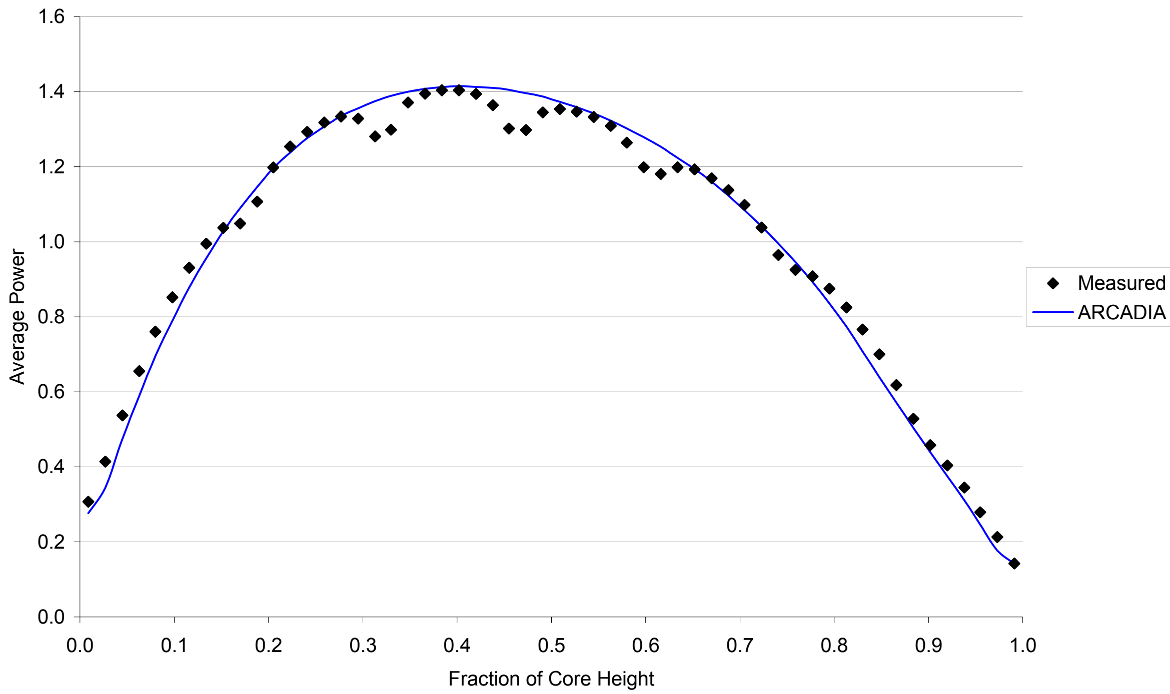
Figure B 10.4.2-4: Plant B EOC 1 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.670 0.670 0.1	0.815 0.813 0.1	0.670 0.670 0.0						
2					0.700 0.695 0.5	0.956 0.953 0.3	1.109 1.108 0.1	0.988 0.984 0.4	1.109 1.108 0.0	0.956 0.960 -0.4	0.700 0.703 -0.3				
3				0.745 0.742 0.3	1.090 1.079 1.2	1.105 1.102 0.3	1.047 1.053 -0.6	1.134 1.118 1.6	1.047 1.047 0.0	1.105 1.110 -0.5	1.090 1.096 -0.5	0.745 0.752 -0.7			
4			0.745 0.734 1.1	0.909 0.897 1.2	1.100 1.074 2.6	1.046 1.043 0.3	1.125 1.135 -1.0	1.038 1.057 -1.9	1.125 1.136 -1.1	1.046 1.057 -1.1	1.100 1.105 -0.4	0.909 0.905 0.3	0.745 0.741 0.5		
5		0.700 0.691 0.8	1.090 1.071 1.9	1.100 1.092 0.8	1.033 1.040 -0.8	1.113 1.119 -0.6	1.024 1.037 -1.3	1.110 1.128 -1.8	1.024 1.036 -1.2	1.113 1.121 -0.8	1.033 1.036 -0.4	1.100 1.079 2.1	1.090 1.081 0.9	0.700 0.705 -0.5	
6		0.956 0.950 0.6	1.105 1.099 0.6	1.046 1.041 0.5	1.113 1.105 0.7	1.016 1.020 -0.5	1.087 1.101 -1.4	1.013 1.035 -2.2	1.087 1.101 -1.4	1.016 1.019 -0.4	1.113 1.115 -0.2	1.046 1.040 0.6	1.105 1.096 0.9	0.956 0.948 0.8	
7	0.670 0.667 0.3	1.109 1.106 0.3	1.047 1.054 -0.7	1.125 1.125 0.0	1.024 1.023 0.1	1.087 1.093 -0.6	1.011 1.025 -1.4	1.099 1.117 -1.8	1.011 1.028 -1.6	1.087 1.099 -1.2	1.024 1.030 -0.6	1.125 1.128 -0.3	1.047 1.037 0.9	1.109 1.088 2.1	0.670 0.660 1.0
8	0.815 0.809 0.6	0.988 0.981 0.7	1.134 1.122 1.1	1.038 1.036 0.2	1.110 1.108 0.2	1.013 1.019 -0.6	1.099 1.110 -1.1	1.016 1.030 -1.4	1.099 1.118 -1.9	1.013 1.034 -2.0	1.110 1.118 -0.8	1.038 1.038 0.0	1.134 1.119 1.5	0.988 0.970 1.8	0.815 0.807 0.7
9	0.670 0.665 0.5	1.109 1.099 1.0	1.047 1.039 0.8	1.125 1.128 -0.3	1.024 1.044 -2.0	1.087 1.096 -1.0	1.011 1.018 -0.7	1.099 1.111 -1.2	1.011 1.032 -2.1	1.087 1.087 0.0	1.024 1.029 -0.5	1.125 1.128 -0.3	1.047 1.043 0.3	1.109 1.104 0.5	0.670 0.678 -0.8
10		0.956 0.946 1.0	1.105 1.089 1.6	1.046 1.045 0.1	1.113 1.121 -0.9	1.016 1.020 -0.4	1.087 1.081 0.6	1.013 1.018 -0.4	1.087 1.094 -0.8	1.016 1.019 -0.3	1.113 1.120 -0.8	1.046 1.055 -1.0	1.105 1.106 -0.1	0.956 0.954 0.1	
11		0.700 0.694 0.6	1.090 1.084 0.7	1.100 1.101 -0.1	1.033 1.041 -0.9	1.113 1.116 -0.4	1.024 1.024 0.0	1.110 1.112 -0.3	1.024 1.025 -0.1	1.113 1.110 0.3	1.033 1.044 -1.1	1.100 1.103 -0.3	1.090 1.091 -0.1	0.700 0.699 0.0	
12			0.745 0.747 -0.1	0.909 0.910 -0.1	1.100 1.103 -0.3	1.046 1.047 -0.1	1.125 1.124 0.1	1.038 1.034 0.4	1.125 1.119 0.6	1.046 1.039 0.7	1.100 1.095 0.5	0.909 0.897 1.1	0.745 0.745 0.0		
13				0.745 0.745 0.0	1.090 1.089 0.1	1.105 1.104 0.1	1.047 1.044 0.3	1.134 1.121 1.3	1.047 1.035 1.2	1.105 1.090 1.5	1.090 1.078 1.2	0.745 0.737 0.9			
14					0.700 0.697 0.3	0.956 0.955 0.1	1.109 1.109 -0.1	0.988 0.981 0.7	1.109 1.090 1.9	0.956 0.942 1.4	0.700 0.691 0.9				
15							0.670 0.685 -1.5	0.815 0.815 0.0	0.670 0.664 0.6						

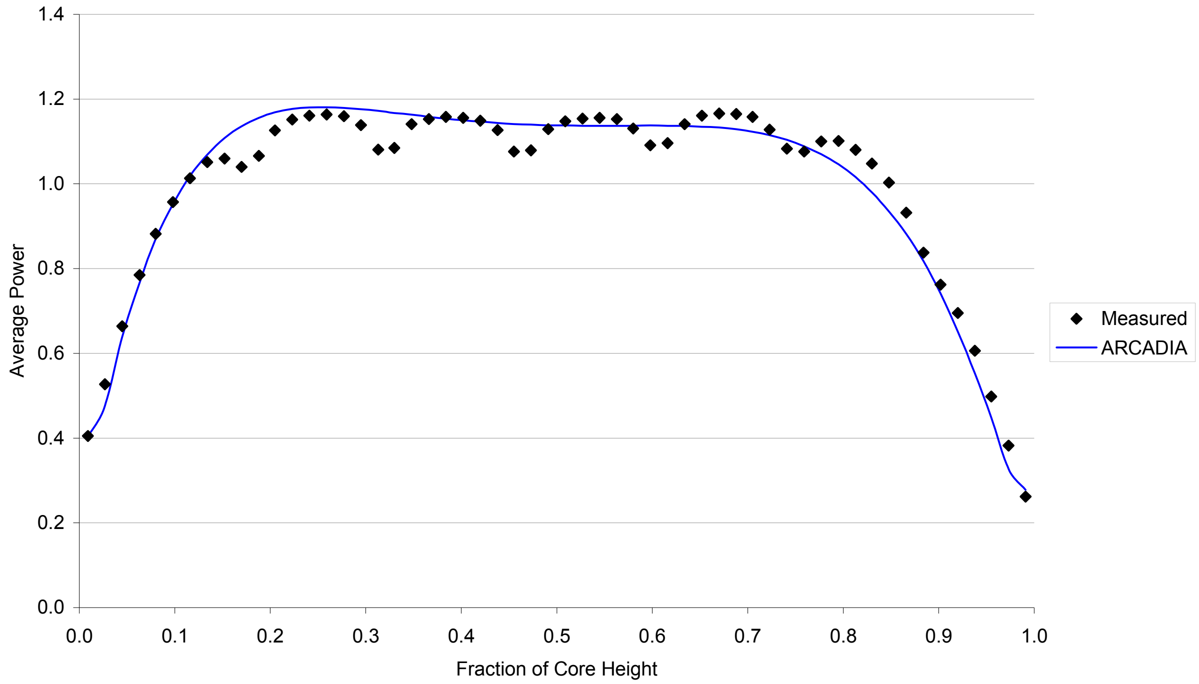
Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.9

Figure B 10.4.2-5: Plant B BOC 1 Core Average Axial Power Distribution



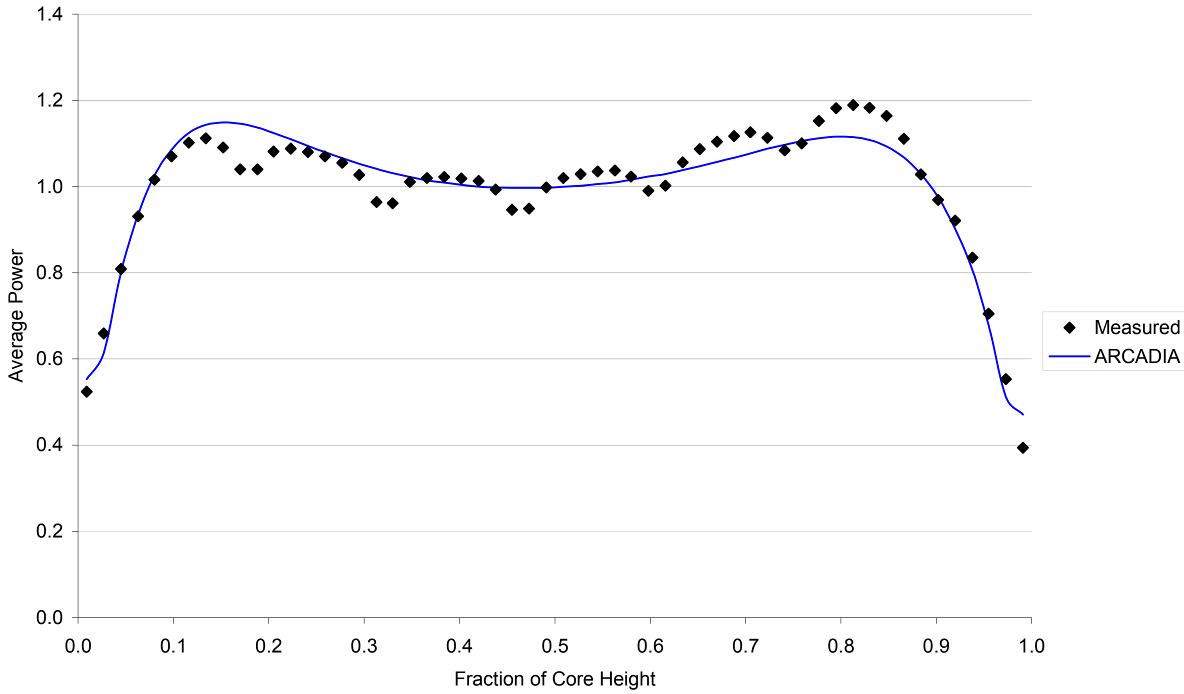
C - M Average Axial Power, RMS Difference *100 = 4.3

Figure B 10.4.2-6: Plant B MOC 1 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 4.2

Figure B 10.4.2-7: Plant B EOC 1 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 4.3

Appendix C

Table C 10.3.3-1: Plant C Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 10-18

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
10	1310	1308	-2
11	1141	1128	-13
12	1339	1329	-10
13 [a]	1464	1451	-13
14	1684	1684	0
15	1612	1608	-4
16 [a]	1661	1646	-15
17 [a]	1553	1544	-9
18	1588	1603	15

[a] Data not at ARO

Table C 10.3.3-2: Plant C Cycle 10 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	1078	1070	-8	-0.8
B	526	503	-23	-4.4
1	989	953	-35	-3.6
2	776	788	12	1.5
3	393	382	-10	-2.6
4	603	606	3	0.5
5	392	378	-14	-3.6
6	457	457	0	0.0
7	824	793	-32	-3.8
Total	6037	5930	-107	-1.8

Table C 10.3.3-3: Plant C Cycle 11 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	1167	1065	-102	-8.8
B	524	477	-47	-8.9
1	755	716	-39	-5.1
2	752	683	-69	-9.2
3	534	500	-34	-6.4
4	798	743	-55	-6.9
5	351	305	-46	-13.1
6	505	437	-68	-13.4
7	903	854	-49	-5.4
Total	6290	5781	-509	-8.1

Table C 10.3.3-4: Plant C Cycle 12 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	965	889	-76	-7.9
B	504	501	-3	-0.7
1	786	753	-33	-4.2
2	840	811	-29	-3.4
3	442	412	-30	-6.9
4	655	621	-34	-5.2
5	396	385	-11	-2.8
6	372	358	-14	-3.9
7	763	722	-41	-5.4
Total	5723	5451	-272	-4.8

Table C 10.3.3-5: Plant C Cycle 13 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	999	1077	77	7.7
B	413	442	30	7.2
1	665	708	43	6.4
2	676	741	65	9.6
3	438	448	10	2.3
4	651	682	31	4.8
5	306	333	27	8.9
6	367	394	27	7.4
7	678	711	33	4.8
Total	5193	5535	342	6.6

Table C 10.3.3-6: Plant C Cycle 14 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	954	1025	72	7.5
B	485	448	-36	-7.5
1	656	681	25	3.8
2	700	703	3	0.4
3	410	404	-5	-1.3
4	616	642	26	4.2
5	375	350	-25	-6.6
6	360	344	-16	-4.3
7	709	728	19	2.6
Total	5265	5326	62	1.2

Table C 10.3.3-7: Plant C Cycle 15 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	1105	1097	-9	-0.8
B	427	413	-14	-3.3
1	787	789	3	0.3
2	885	877	-8	-0.9
3	508	474	-34	-6.7
4	730	694	-36	-5.0
5	361	342	-19	-5.3
6	406	370	-36	-8.9
7	903	852	-50	-5.6
Total	6112	5907	-205	-3.4

Table C 10.4.3-8: Plant C Cycle 16 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	874	959	85	9.7
B	507	457	-50	-9.8
1	679	675	-4	-0.5
2	819	822	2	0.3
3	503	492	-11	-2.2
4	690	688	-2	-0.2
5	353	318	-35	-9.9
6	355	322	-33	-9.3
7	748	753	5	0.7
Total	5528	5486	-42	-0.8

Table C 10.3.3-9: Plant C Cycle 17 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
A	1039	1064	25	2.4
B	447	414	-34	-7.5
1	775	761	-14	-1.8
2	730	735	5	0.7
3	558	537	-21	-3.8
4	708	719	11	1.5
5	341	311	-30	-8.8
6	364	343	-21	-5.7
7	873	867	-6	-0.7
Total	5837	5752	-84	-1.4

Table C 10.3.3-10: Plant C Summary of Total Bank Worths

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/C (%)
10	6037	5930	-107	-1.8
11	6290	5781	-509	-8.1
12	5723	5451	-272	-4.8
13	5193	5535	342	6.6
14	5265	5326	62	1.2
15	6112	5907	-205	-3.4
16	5528	5486	-42	-0.8
17	5837	5752	-84	-1.4

Table C 10.3.3-11: Plant C Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 10-18

Cycle	Measured (pcm/ºF)	Calculated (pcm/ºF)	Difference C - M (pcm/ºF)
10 [a]	2.47	2.98	0.51
11 [a]	-1.16	-0.74	0.42
12	0.79	1.37	0.58
13	0.65	1.03	0.38
14	2.20	2.65	0.45
15 [a]	0.93	1.62	0.69
16 [a]	1.29	2.03	0.74
17 [a]	0.78	0.93	0.16
18 [a]	1.39	1.36	-0.03

[a] Data not at ARO.

Figure C 10.2.1-3: Plant C Fuel Assembly Guide Tube Configuration

<table>
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</table>

1	UO_2 Rod
2	Guide tube with instrument
3	Guide tube

Figure C 10.4.3-1: Plant C Cycle 10 Critical Boron Concentration vs. Burnup

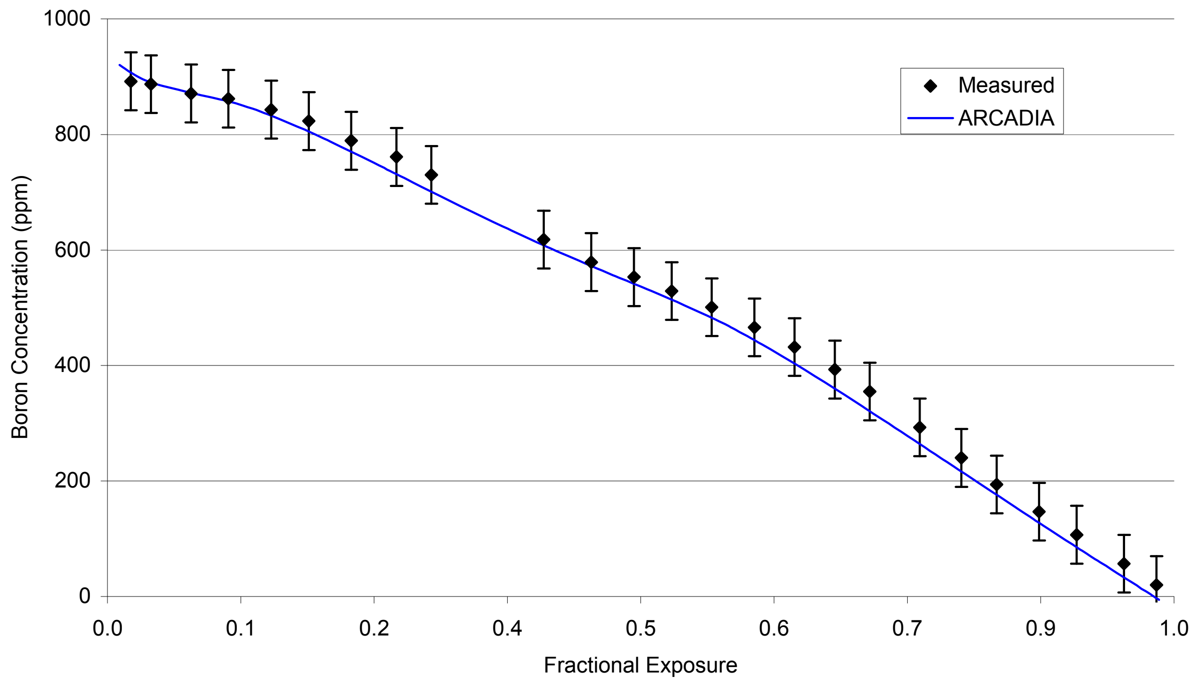


Figure C 10.4.3-2: Plant C Cycle 11 Critical Boron Concentration vs. Burnup

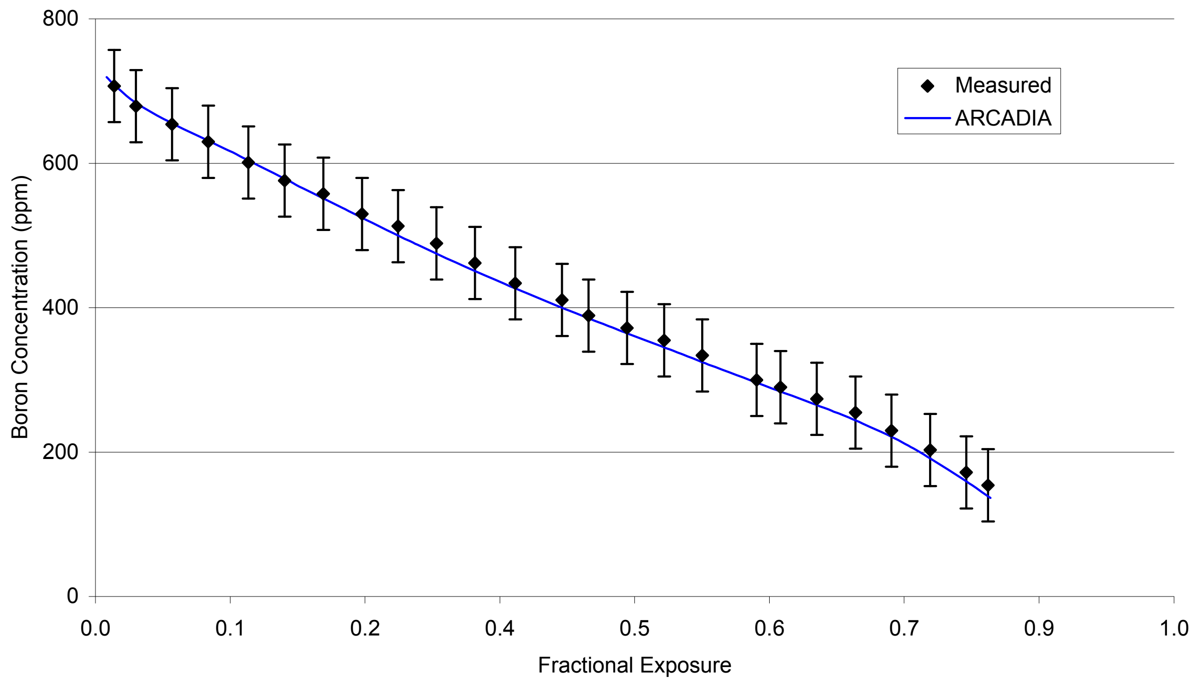


Figure C 10.4.3-3: Plant C Cycle 12 Critical Boron Concentration vs. Burnup

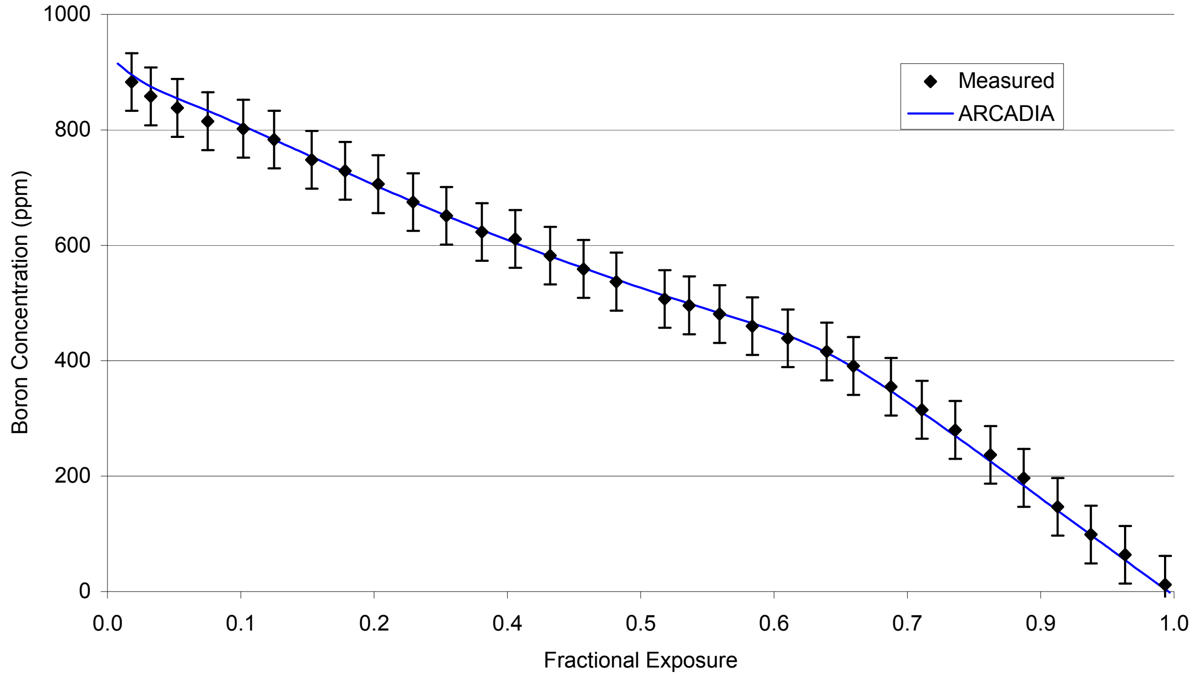


Figure C 10.4.3-4: Plant C Cycle 13 Critical Boron Concentration vs. Burnup

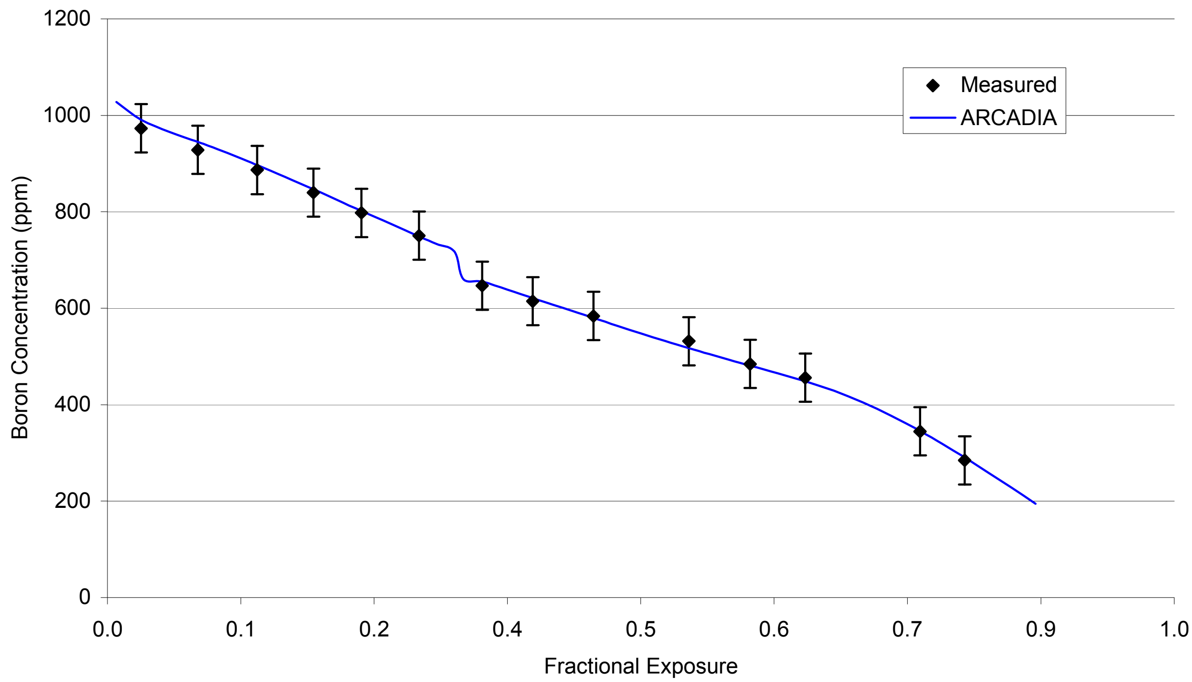


Figure C 10.4.3-5: Plant C Cycle 14 Critical Boron Concentration vs. Burnup

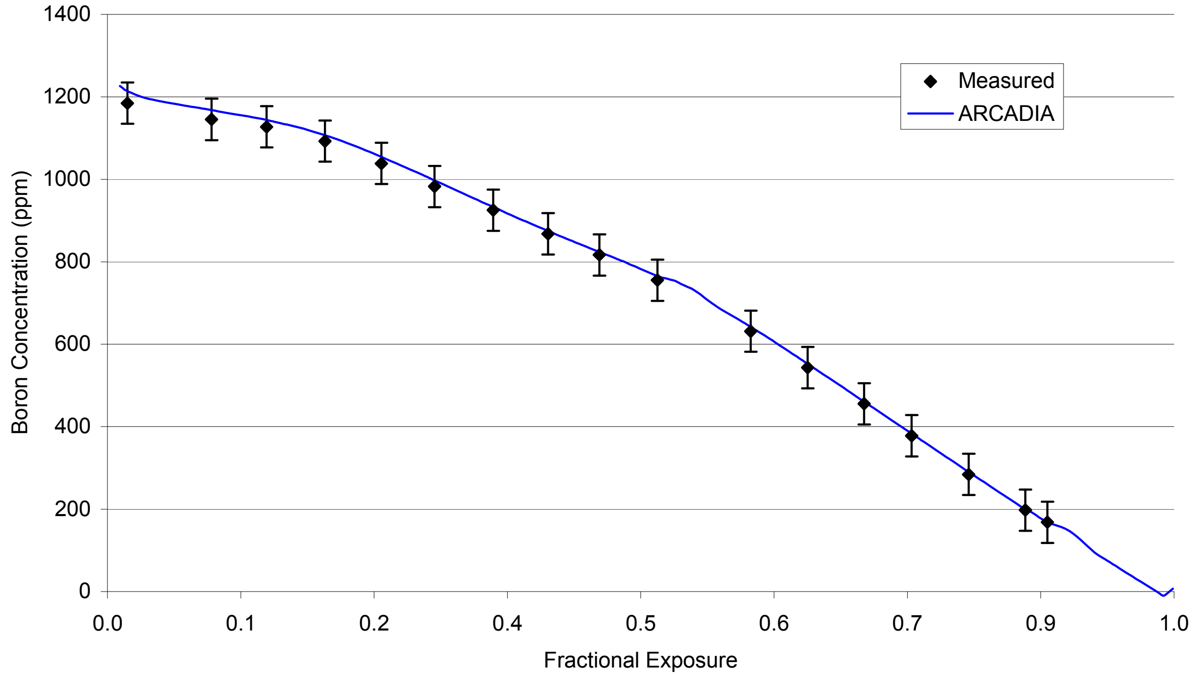


Figure C 10.4.3-6: Plant C Cycle 15 Critical Boron Concentration vs. Burnup

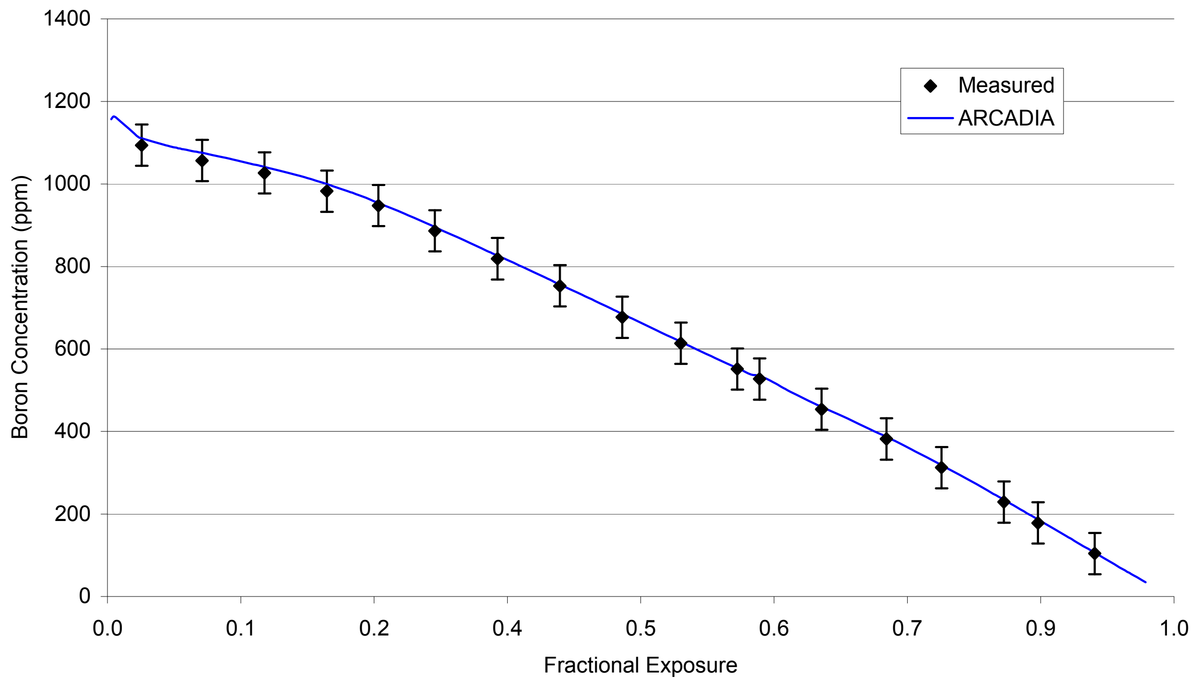


Figure C 10.4.3-7: Plant C Cycle 16 Critical Boron Concentration vs. Burnup

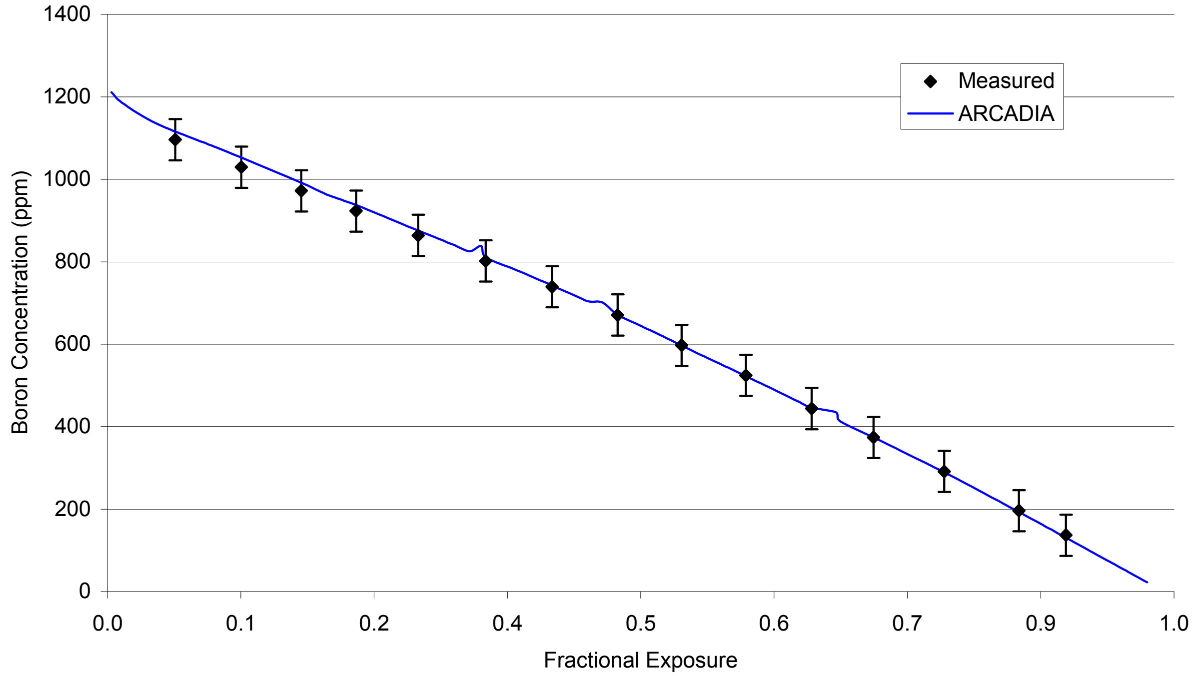


Figure C 10.4.3-8: Plant C Cycle 17 Critical Boron Concentration vs. Burnup

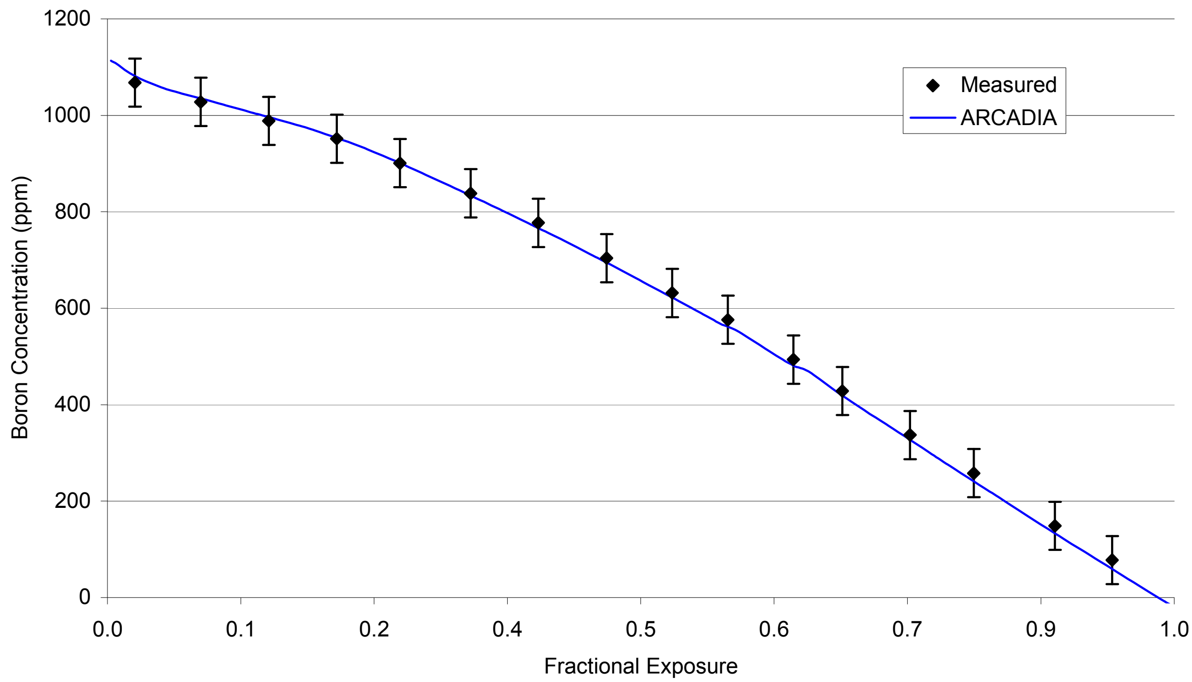


Figure C 10.4.3-9: Plant C Cycle 18 Critical Boron Concentration vs. Burnup

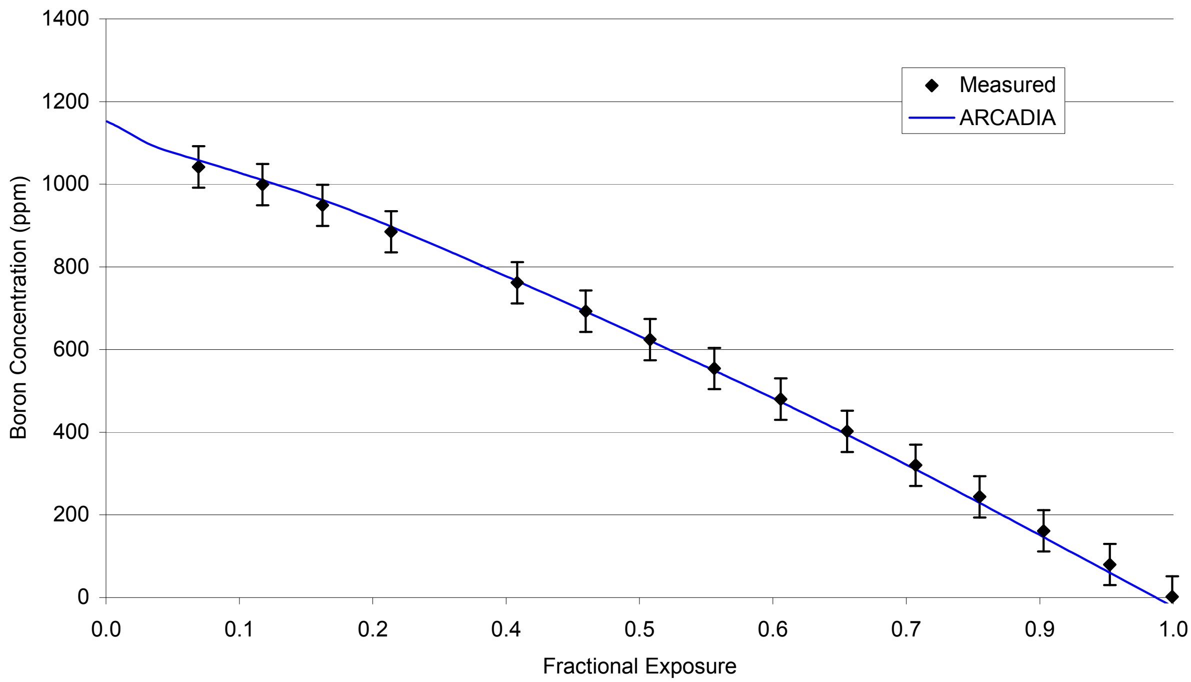


Figure C 10.4.3-10: Plant C BOC 10 Assembly Average Radial Power Distribution

Figure C 10.4.3-11: Plant C MOC 10 Assembly Average Radial Power Distribution

Figure C 10.4.3-12: Plant C EOC 10 Assembly Average Radial Power Distribution

Figure C 10.4.3-13: Plant C BOC 11 Assembly Average Radial Power Distribution

Figure C 10.4.3-14: Plant C MOC 11 Assembly Average Radial Power Distribution

Figure C 10.4.3-15: Plant C EOC 11 Assembly Average Radial Power Distribution

Figure C 10.4.3-16: Plant C BOC 12 Assembly Average Radial Power Distribution

Figure C 10.4.3-17: Plant C MOC 12 Assembly Average Radial Power Distribution

1

Figure C 10.4.3-18: Plant C EOC 12 Assembly Average Radial Power Distribution

Figure C 10.4.3-19: Plant C BOC 13 Assembly Average Radial Power Distribution

Figure C 10.4.3-20: Plant C MOC 13 Assembly Average Radial Power Distribution

Figure C 10.4.3-21: Plant C EOC 13 Assembly Average Radial Power Distribution

Figure C 10.4.3-22: Plant C BOC 14 Assembly Average Radial Power Distribution

Figure C 10.4.3-23: Plant C MOC 14 Assembly Average Radial Power Distribution

Figure C 10.4.3-24: Plant C EOC 14 Assembly Average Radial Power Distribution

Figure C 10.4.3-25: Plant C BOC 15 Assembly Average Radial Power Distribution

Figure C 10.4.3-26: Plant C MOC 15 Assembly Average Radial Power Distribution

Figure C 10.4.3-27: Plant C EOC 15 Assembly Average Radial Power Distribution

Figure C 10.4.3-28: Plant C BOC 16 Assembly Average Radial Power Distribution

Figure C 10.4.3-29: Plant C MOC 16 Assembly Average Radial Power Distribution

Figure C 10.4.3-30: Plant C EOC 16 Assembly Average Radial Power Distribution

Figure C 10.4.3-31: Plant C BOC 17 Assembly Average Radial Power Distribution

Figure C 10.4.3-32: Plant C MOC 17 Assembly Average Radial Power Distribution

Figure C 10.4.3-33: Plant C EOC 17 Assembly Average Radial Power Distribution

Figure C 10.4.3-34: Plant C BOC 18 Assembly Average Radial Power Distribution

Figure C 10.4.3-35: Plant C MOC 18 Assembly Average Radial Power Distribution

Figure C 10.4.3-36: Plant C EOC 18 Assembly Average Radial Power Distribution

Figure C 10.4.3-37: Plant C BOC 10 Core Average Axial Power Distribution

Figure C 10.4.3-38: Plant C MOC 10 Core Average Axial Power Distribution

Figure C 10.4.3-39: Plant C EOC 10 Core Average Axial Power Distribution

Figure C 10.4.3-40: Plant C BOC 11 Core Average Axial Power Distribution

Figure C 10.4.3-41: Plant C MOC 11 Core Average Axial Power Distribution

Figure C 10.4.3-42: Plant C EOC 11 Core Average Axial Power Distribution

Figure C 10.4.3-43: Plant C BOC 12 Core Average Axial Power Distribution

Figure C 10.4.3-44: Plant C MOC 12 Core Average Axial Power Distribution

Figure C 10.4.3-45: Plant C EOC 12 Core Average Axial Power Distribution

Figure C 10.4.3-46: Plant C BOC 13 Core Average Axial Power Distribution

Figure C 10.4.3-47: Plant C MOC 13 Core Average Axial Power Distribution

Figure C 10.4.3-48: Plant C EOC 13 Core Average Axial Power Distribution

Figure C 10.4.3-49: Plant C BOC 14 Core Average Axial Power Distribution

Figure C 10.4.3-50: Plant C MOC 14 Core Average Axial Power Distribution

Figure C 10.4.3-51: Plant C EOC 14 Core Average Axial Power Distribution

Figure C 10.4.3-52: Plant C BOC 15 Core Average Axial Power Distribution

Figure C 10.4.3-53: Plant C MOC 15 Core Average Axial Power Distribution

Figure C 10.4.3-54: Plant C EOC 15 Core Average Axial Power Distribution

Figure C 10.4.3-55: Plant C BOC 16 Core Average Axial Power Distribution

Figure C 10.4.3-56: Plant C MOC 16 Core Average Axial Power Distribution

Figure C 10.4.3-57: Plant C EOC 16 Core Average Axial Power Distribution

Figure C 10.4.3-58: Plant C BOC 17 Core Average Axial Power Distribution

Figure C 10.4.3-59: Plant C MOC 17 Core Average Axial Power Distribution

Figure C 10.4.3-60: Plant C EOC 17 Core Average Axial Power Distribution

Figure C 10.4.3-61: Plant C BOC 18 Core Average Axial Power Distribution

Figure C 10.4.3-62: Plant C MOC 18 Core Average Axial Power Distribution

[ ]

Figure C 10.4.3-63: Plant C EOC 18 Core Average Axial Power Distribution

Appendix G1

Table G1 10.3.4-1: Plant G1 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 26-30

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
26	1688	1642	-46
27	1779	1757	-22
28	1651	1593	-58*
29	1703	1648	-55*
30	1774	1716	-58*

* Within acceptance criteria when cycle-specific boron worths are applied to the ± 500 pcm equivalent criteria: cycle 28: acceptance criterion ± 60 ppm, cycle 29: ± 61 ppm, cycle 30: ± 63 ppm.

Data on HZP all rods out isothermal temperature coefficients is not available for Plant G1.

Figure G1 10.2.1-4: Plant G1 Fuel Assembly Guide Tube Configuration

3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	1	3	3	1	3	3	1	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	2	3	3
3	3	3	3	1	3	3	1	3	3	1	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1	Guide tube
2	Guide tube with instrument
3	UO_2 Rod

Figure G1 10.4.4-1: Plant G1 Cycle 26 Critical Boron Concentration vs. Burnup

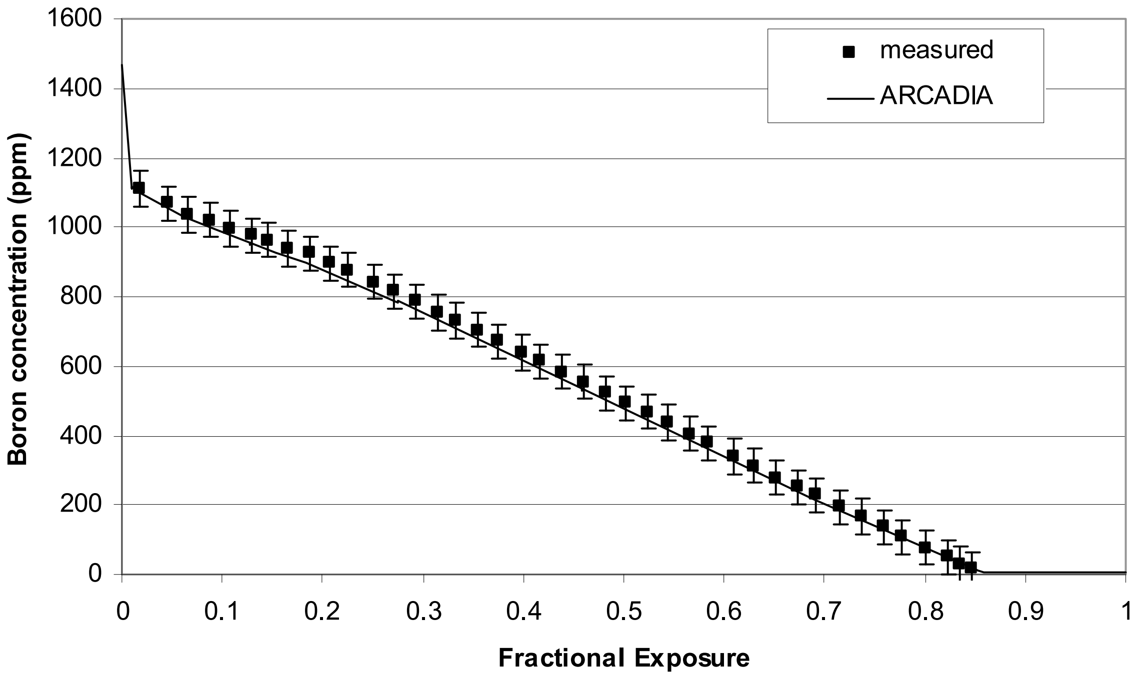


Figure G1 10.4.4-2: Plant G1 Cycle 27 Critical Boron Concentration vs. Burnup

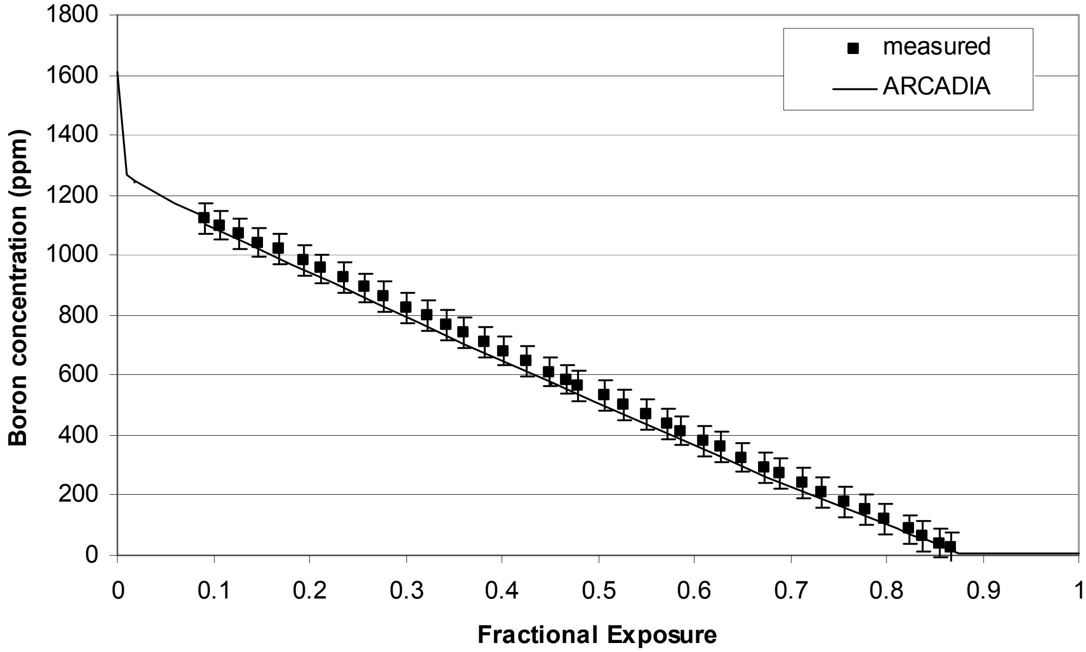


Figure G1 10.4.4-3: Plant G1 Cycle 28 Critical Boron Concentration vs. Burnup

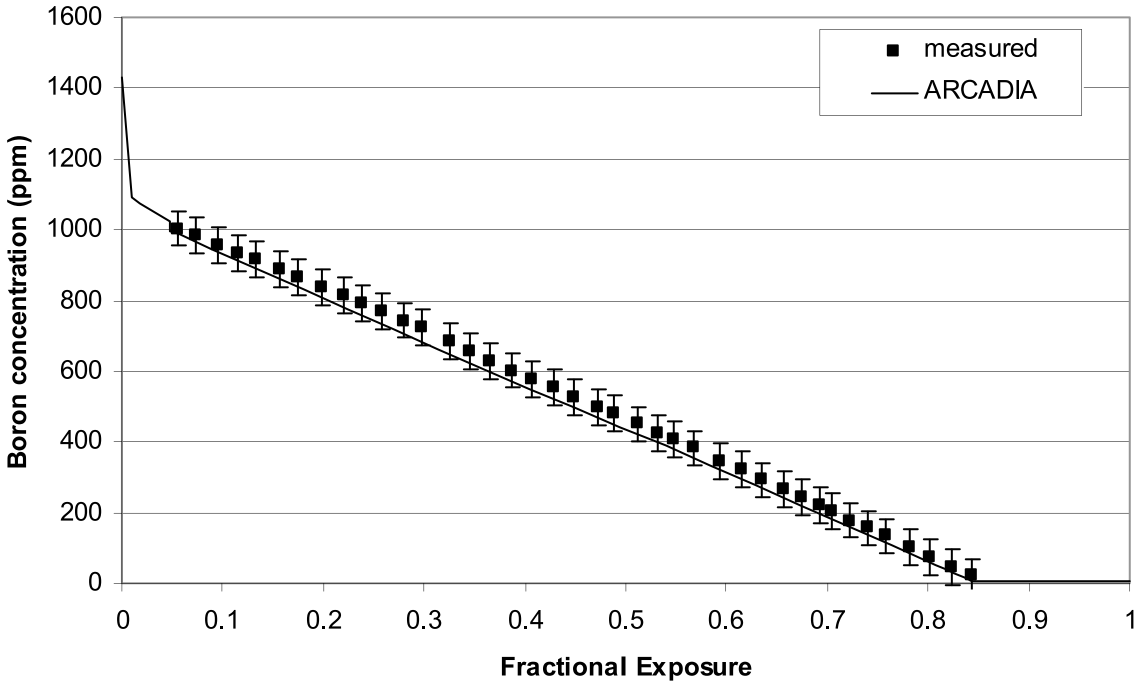


Figure G1 10.4.4-4: Plant G1 Cycle 29 Critical Boron Concentration vs. Burnup

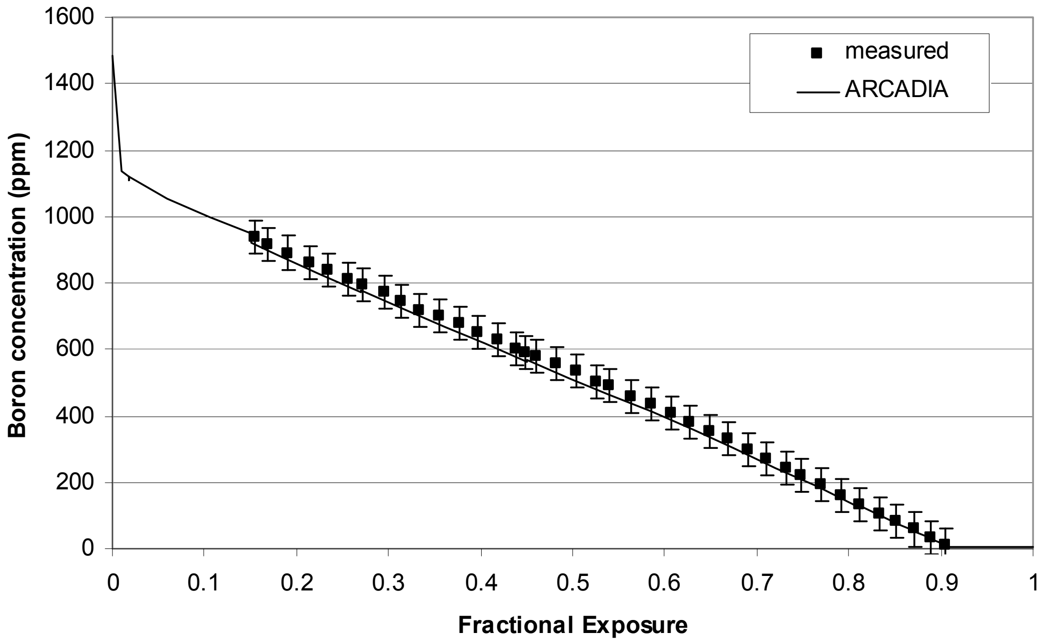


Figure G1 10.4.4-5: Plant G1 Cycle 30 Critical Boron Concentration vs. Burnup

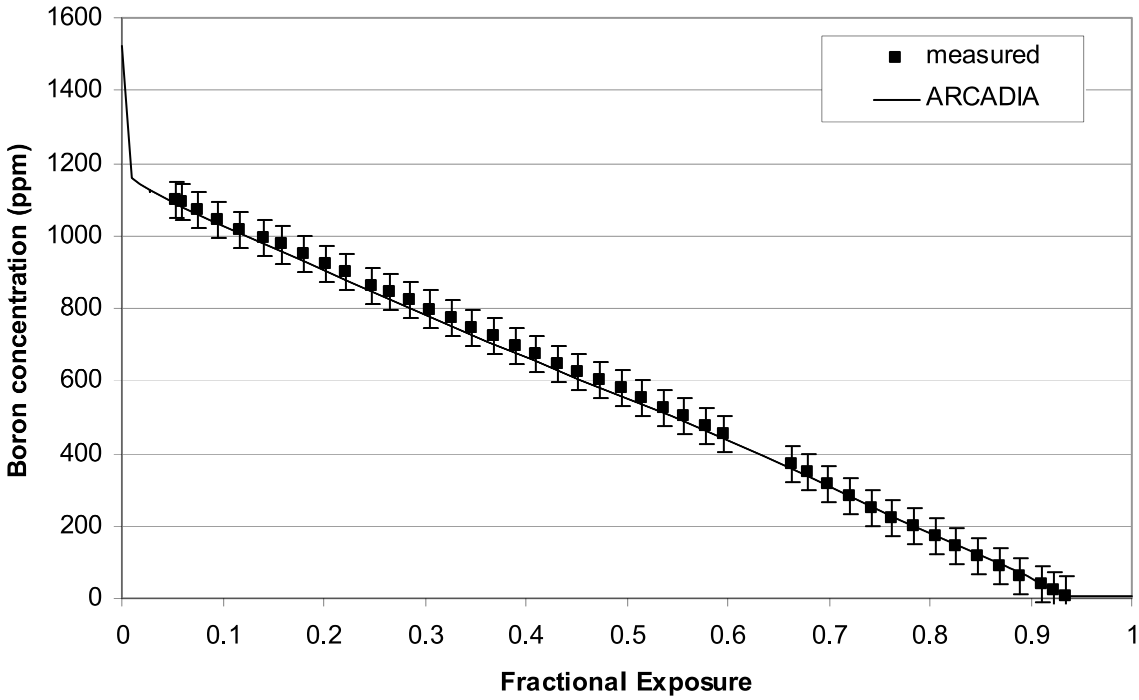


Figure G1 10.4.4-6: Plant G1 BOC 26 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.260 0.257 0.3	0.360 0.355 0.5	0.400 0.393 0.7	0.361 0.355 0.6	0.261 0.260 0.1					
O				0.290 0.286 0.3	0.512 0.507 0.6	1.063 1.051 1.2	1.306 1.289 1.7	1.332 1.308 2.4	1.305 1.276 2.9	1.058 1.044 1.4	0.506 0.500 0.6	0.286 0.284 0.3			
N			0.384 0.378 0.6	1.140 1.126 1.4	1.348 1.334 1.4	0.992 0.982 0.9	1.306 1.292 1.4	1.033 1.018 1.5	1.303 1.281 2.2	0.985 0.971 1.4	1.323 1.307 1.6	1.132 1.122 1.0	0.384 0.382 0.2		
M		0.287 0.282 0.5	1.132 1.110 2.2	1.197 1.182 1.5	1.272 1.261 1.1	1.382 1.373 0.9	1.036 1.031 0.5	1.399 1.386 1.3	1.035 1.023 1.1	1.377 1.361 1.5	1.265 1.251 1.4	1.197 1.189 0.7	1.140 1.136 0.4	0.290 0.290 0.0	
L		0.506 0.500 0.7	1.323 1.306 1.7	1.266 1.257 0.8	1.044 1.038 0.6	1.415 1.408 0.8	1.100 1.094 0.5	0.927 0.921 0.6	1.100 1.092 0.8	1.416 1.406 0.9	1.043 1.038 0.5	1.272 1.269 0.3	1.348 1.347 0.0	0.512 0.513 -0.1	
K	0.261 0.258 0.3	1.058 1.047 1.1	0.985 0.976 0.9	1.377 1.368 0.9	1.416 1.407 0.9	1.340 1.332 0.8	0.969 0.964 0.5	1.352 1.346 0.6	0.970 0.967 0.4	1.339 1.335 0.4	1.415 1.413 0.2	1.382 1.383 -0.2	0.992 0.997 -0.5	1.063 1.067 -0.5	0.260 0.262 -0.2
J	0.361 0.357 0.4	1.305 1.292 1.3	1.303 1.291 1.2	1.035 1.027 0.8	1.101 1.093 0.7	0.971 0.965 0.7	1.112 1.107 0.5	1.095 1.092 0.3	1.110 1.108 0.2	0.968 0.968 0.0	1.099 1.101 -0.2	1.036 1.041 -0.4	1.306 1.313 -0.7	1.307 1.316 -0.9	0.360 0.365 -0.5
H	0.400 0.395 0.4	1.332 1.318 1.4	1.033 1.023 1.0	1.399 1.389 1.0	0.927 0.922 0.5	1.353 1.347 0.6	1.097 1.095 0.3	0.803 0.803 0.0	1.093 1.094 -0.1	1.351 1.353 -0.2	0.926 0.931 -0.4	1.399 1.408 -0.9	1.033 1.043 -1.0	1.332 1.347 -1.5	0.400 0.408 -0.8
G	0.360 0.356 0.4	1.306 1.289 1.7	1.306 1.292 1.4	1.036 1.029 0.7	1.100 1.095 0.5	0.970 0.968 0.2	1.112 1.113 -0.1	1.096 1.099 -0.3	1.110 1.114 -0.4	0.971 0.974 -0.4	1.100 1.108 -0.8	1.035 1.045 -1.1	1.303 1.318 -1.5	1.305 1.322 -1.7	0.361 0.366 -0.5
F	0.260 0.257 0.3	1.063 1.050 1.2	0.992 0.981 1.0	1.382 1.373 0.9	1.415 1.411 0.4	1.340 1.340 0.0	0.971 0.974 -0.3	1.353 1.362 -0.9	0.969 0.979 -0.9	1.340 1.354 -1.5	1.416 1.432 -1.6	1.377 1.396 -1.9	0.985 0.999 -1.4	1.058 1.073 -1.6	0.261 0.265 -0.4
E		0.512 0.508 0.4	1.348 1.338 0.9	1.272 1.267 0.5	1.043 1.043 0.1	1.416 1.419 -0.3	1.100 1.107 -0.6	0.927 0.937 -1.0	1.100 1.119 -1.9	1.415 1.440 -2.5	1.043 1.061 -1.8	1.266 1.289 -2.3	1.323 1.347 -2.4	0.506 0.515 -0.9	
D		0.290 0.288 0.2	1.140 1.136 0.4	1.197 1.195 0.2	1.266 1.267 -0.1	1.377 1.382 -0.5	1.035 1.042 -0.7	1.399 1.417 -1.8	1.036 1.061 -2.5	1.382 1.412 -3.0	1.272 1.297 -2.5	1.197 1.220 -2.4	1.132 1.156 -2.4	0.287 0.292 -0.6	
C			0.384 0.384 0.1	1.132 1.133 -0.1	1.323 1.327 -0.3	0.985 0.990 -0.5	1.303 1.309 -0.6	1.033 1.044 -1.0	1.306 1.327 -2.1	0.992 1.010 -1.8	1.348 1.373 -2.6	1.140 1.163 -2.2	0.384 0.392 -0.8		
B				0.286 0.287 -0.1	0.506 0.509 -0.3	1.058 1.068 -1.1	1.305 1.308 -0.3	1.332 1.341 -0.9	1.307 1.324 -1.7	1.063 1.080 -1.7	0.512 0.521 -0.9	0.290 0.295 -0.6			
A						0.261 0.269 -0.8	0.361 0.366 -0.5	0.400 0.404 -0.4	0.360 0.365 -0.5	0.260 0.264 -0.4					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.1

Figure G1 10.4.4-7: Plant G1 MOC 26 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.277 0.276 0.1	0.370 0.368 0.2	0.404 0.401 0.3	0.371 0.370 0.1	0.279 0.281 -0.2					
O				0.315 0.314 0.1	0.544 0.542 0.2	1.050 1.046 0.4	1.232 1.226 0.6	1.247 1.237 1.0	1.233 1.221 1.2	1.051 1.045 0.6	0.544 0.540 0.4	0.315 0.312 0.3			
N			0.405 0.403 0.2	1.134 1.130 0.5	1.383 1.379 0.4	0.987 0.984 0.2	1.258 1.253 0.5	1.017 1.010 0.6	1.258 1.246 1.1	0.987 0.977 1.0	1.383 1.366 1.7	1.134 1.123 1.1	0.405 0.402 0.3		
M		0.315 0.313 0.2	1.134 1.125 0.9	1.158 1.153 0.5	1.235 1.233 0.2	1.331 1.330 0.1	1.039 1.040 0.0	1.452 1.447 0.6	1.039 1.033 0.7	1.331 1.318 1.3	1.235 1.219 1.6	1.159 1.148 1.0	1.134 1.128 0.7	0.315 0.314 0.1	
L		0.544 0.541 0.3	1.383 1.375 0.8	1.235 1.235 0.0	1.019 1.019 0.0	1.354 1.354 0.1	1.111 1.111 0.0	0.975 0.973 0.2	1.112 1.108 0.5	1.356 1.348 0.8	1.019 1.013 0.6	1.235 1.230 0.6	1.383 1.378 0.5	0.544 0.543 0.1	
K	0.279 0.277 0.2	1.051 1.044 0.7	0.987 0.982 0.5	1.331 1.329 0.3	1.356 1.353 0.3	1.307 1.305 0.2	1.007 1.007 0.0	1.459 1.457 0.2	1.008 1.007 0.1	1.306 1.303 0.3	1.354 1.351 0.3	1.331 1.330 0.2	0.987 0.988 -0.1	1.050 1.050 0.0	0.277 0.278 -0.1
J	0.371 0.367 0.3	1.233 1.223 1.0	1.258 1.249 0.9	1.039 1.034 0.5	1.113 1.109 0.3	1.009 1.008 0.1	1.165 1.165 0.0	1.157 1.158 0.0	1.163 1.164 -0.1	1.007 1.007 -0.1	1.111 1.112 -0.1	1.039 1.041 -0.2	1.258 1.260 -0.2	1.232 1.235 -0.3	0.370 0.372 -0.3
H	0.404 0.399 0.5	1.247 1.233 1.4	1.016 1.006 1.0	1.452 1.442 1.0	0.975 0.971 0.4	1.460 1.457 0.2	1.160 1.160 -0.1	0.877 0.878 -0.2	1.156 1.159 -0.3	1.459 1.462 -0.3	0.975 0.978 -0.3	1.453 1.457 -0.5	1.017 1.022 -0.5	1.247 1.254 -0.7	0.404 0.409 -0.5
G	0.370 0.364 0.6	1.232 1.212 2.1	1.258 1.241 1.7	1.039 1.029 1.0	1.112 1.105 0.6	1.007 1.006 0.2	1.165 1.167 -0.1	1.159 1.163 -0.4	1.164 1.170 -0.6	1.008 1.014 -0.5	1.112 1.118 -0.5	1.039 1.046 -0.7	1.258 1.267 -0.9	1.233 1.243 -1.0	0.371 0.374 -0.4
F	0.277 0.272 0.4	1.050 1.032 1.8	0.987 0.970 1.7	1.331 1.316 1.6	1.354 1.345 0.9	1.307 1.304 0.3	1.009 1.011 -0.2	1.459 1.467 -0.8	1.007 1.016 -0.9	1.307 1.318 -1.1	1.356 1.365 -0.9	1.331 1.344 -1.2	0.987 0.998 -1.1	1.051 1.062 -1.1	0.279 0.282 -0.3
E		0.544 0.536 0.8	1.383 1.363 2.0	1.235 1.221 1.4	1.019 1.012 0.7	1.356 1.353 0.4	1.113 1.116 -0.3	0.975 0.984 -0.9	1.111 1.129 -1.7	1.354 1.375 -2.0	1.019 1.032 -1.3	1.235 1.252 -1.7	1.383 1.403 -2.0	0.544 0.552 -0.8	
D		0.315 0.311 0.4	1.134 1.121 1.3	1.158 1.147 1.2	1.235 1.222 1.3	1.331 1.327 0.5	1.039 1.043 -0.4	1.453 1.468 -1.5	1.039 1.063 -2.4	1.331 1.357 -2.6	1.235 1.255 -2.0	1.158 1.178 -1.9	1.134 1.155 -2.1	0.315 0.321 -0.6	
C			0.405 0.401 0.4	1.134 1.125 0.9	1.383 1.374 0.8	0.987 0.986 0.0	1.258 1.262 -0.4	1.017 1.026 -1.0	1.258 1.276 -1.9	0.987 1.004 -1.7	1.383 1.406 -2.3	1.134 1.154 -1.9	0.405 0.413 -0.7		
B				0.315 0.314 0.1	0.544 0.544 0.0	1.051 1.059 -0.8	1.233 1.238 -0.5	1.247 1.256 -0.9	1.232 1.248 -1.5	1.050 1.065 -1.6	0.544 0.553 -0.9	0.315 0.321 -0.6			
A						0.279 0.287 -0.8	0.371 0.376 -0.6	0.404 0.408 -0.4	0.370 0.374 -0.5	0.277 0.281 -0.4					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.9

Figure G1 10.4.4-8: Plant G1 EOC 26 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.315 0.315 0.0	0.410 0.410 0.0	0.443 0.442 0.1	0.411 0.410 0.1	0.317 0.318 -0.1					
O				0.348 0.348 0.0	0.580 0.581 -0.1	1.066 1.067 -0.1	1.219 1.219 0.0	1.233 1.228 0.5	1.220 1.211 0.9	1.067 1.063 0.4	0.581 0.578 0.3	0.348 0.346 0.2	Calculated Power Measured Power Difference (C-M)*100		
N			0.439 0.436 0.2	1.126 1.124 0.2	1.347 1.348 -0.1	0.993 0.997 -0.3	1.244 1.248 -0.4	1.020 1.020 0.1	1.244 1.239 0.6	0.993 0.988 0.5	1.347 1.338 0.9	1.126 1.119 0.7	0.439 0.436 0.2		
M		0.348 0.346 0.3	1.126 1.116 1.0	1.148 1.144 0.4	1.206 1.208 -0.2	1.298 1.307 -0.9	1.042 1.053 -1.1	1.419 1.423 -0.5	1.042 1.041 0.1	1.298 1.292 0.5	1.206 1.198 0.8	1.148 1.142 0.6	1.126 1.120 0.6	0.348 0.347 0.2	
L		0.581 0.577 0.4	1.346 1.337 0.9	1.206 1.202 0.4	1.018 1.021 -0.3	1.314 1.325 -1.0	1.112 1.123 -1.1	0.987 0.993 -0.6	1.113 1.116 -0.2	1.315 1.314 0.1	1.017 1.015 0.3	1.206 1.201 0.5	1.347 1.339 0.7	0.580 0.577 0.3	
K	0.317 0.314 0.2	1.067 1.059 0.8	0.993 0.988 0.5	1.298 1.296 0.2	1.315 1.323 -0.8	1.278 1.291 -1.2	1.016 1.026 -1.0	1.427 1.438 -1.0	1.017 1.022 -0.5	1.278 1.281 -0.2	1.314 1.313 0.1	1.298 1.294 0.3	0.993 0.989 0.4	1.066 1.058 0.8	0.315 0.313 0.2
J	0.411 0.407 0.4	1.220 1.209 1.1	1.244 1.236 0.8	1.042 1.040 0.2	1.113 1.119 -0.6	1.017 1.033 -1.6	1.167 1.182 -1.5	1.160 1.171 -1.0	1.166 1.175 -0.8	1.016 1.021 -0.5	1.112 1.114 -0.2	1.042 1.041 0.1	1.244 1.239 0.6	1.219 1.210 0.9	0.410 0.408 0.1
H	0.443 0.438 0.6	1.233 1.217 1.5	1.020 1.011 0.9	1.418 1.412 0.6	0.987 0.989 -0.2	1.428 1.440 -1.3	1.162 1.174 -1.2	0.917 0.926 -0.8	1.159 1.170 -1.1	1.427 1.439 -1.2	0.987 0.990 -0.3	1.419 1.418 0.0	1.021 1.019 0.1	1.233 1.230 0.3	0.443 0.444 0.0
G	0.410 0.403 0.7	1.219 1.196 2.3	1.244 1.226 1.8	1.041 1.033 0.8	1.112 1.110 0.2	1.016 1.020 -0.3	1.168 1.175 -0.7	1.161 1.170 -0.9	1.167 1.179 -1.2	1.017 1.028 -1.1	1.113 1.114 -0.1	1.042 1.042 -0.1	1.244 1.245 0.0	1.220 1.220 0.0	0.411 0.411 0.0
F	0.315 0.309 0.6	1.066 1.045 2.1	0.993 0.974 1.9	1.298 1.282 1.6	1.314 1.306 0.8	1.278 1.277 0.1	1.017 1.021 -0.3	1.427 1.436 -0.8	1.016 1.024 -0.8	1.278 1.283 -0.5	1.315 1.311 0.5	1.298 1.299 -0.2	0.993 0.997 -0.3	1.067 1.069 -0.3	0.317 0.318 -0.1
E		0.580 0.571 1.0	1.347 1.324 2.3	1.206 1.191 1.5	1.017 1.009 0.8	1.315 1.311 0.4	1.113 1.115 -0.1	0.987 0.993 -0.6	1.112 1.123 -1.0	1.314 1.324 -0.9	1.018 1.022 -0.4	1.206 1.212 -0.6	1.346 1.356 -0.9	0.581 0.584 -0.4	
D		0.348 0.343 0.5	1.126 1.111 1.6	1.148 1.135 1.4	1.206 1.193 1.4	1.298 1.291 0.7	1.042 1.042 0.0	1.419 1.424 -0.6	1.041 1.054 -1.3	1.298 1.310 -1.3	1.206 1.216 -1.0	1.148 1.159 -1.0	1.126 1.140 -1.4	0.348 0.352 -0.4	
C			0.439 0.434 0.5	1.126 1.114 1.1	1.346 1.335 1.1	0.993 0.991 0.3	1.244 1.244 0.0	1.020 1.023 -0.2	1.244 1.252 -0.8	0.993 1.002 -0.8	1.347 1.357 -1.1	1.126 1.137 -1.0	0.439 0.443 -0.5		
B				0.348 0.346 0.2	0.581 0.579 0.1	1.067 1.071 -0.5	1.220 1.223 -0.3	1.233 1.236 -0.4	1.219 1.226 -0.7	1.066 1.073 -0.8	0.580 0.585 -0.5	0.348 0.352 -0.3			
A						0.317 0.324 -0.7	0.411 0.415 -0.4	0.443 0.446 -0.3	0.410 0.412 -0.3	0.315 0.317 -0.2					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure G1 10.4.4-9: Plant G1 BOC 27 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.241 0.237 0.4	0.341 0.336 0.5	0.392 0.387 0.5	0.340 0.336 0.3	0.241 0.240 0.1					
O				0.197 0.194 0.3	0.508 0.500 0.7	1.152 1.135 1.7	1.301 1.282 1.9	1.094 1.079 1.5	1.294 1.279 1.5	1.148 1.142 0.6	0.507 0.506 0.1	0.196 0.197 0.0			
N			0.253 0.250 0.3	0.747 0.737 1.0	1.300 1.281 1.9	1.203 1.184 1.9	1.059 1.042 1.7	1.477 1.457 1.9	1.051 1.041 1.0	1.199 1.195 0.4	1.297 1.299 -0.2	0.747 0.749 -0.3	0.253 0.254 -0.1		
M		0.196 0.194 0.2	0.747 0.738 0.9	1.320 1.304 1.6	1.069 1.053 1.5	1.124 1.104 2.1	1.466 1.435 3.1	1.022 1.008 1.3	1.465 1.455 1.0	1.123 1.122 0.2	1.068 1.072 -0.4	1.320 1.327 -0.6	0.748 0.753 -0.5	0.197 0.198 -0.2	
L		0.506 0.502 0.5	1.297 1.284 1.3	1.067 1.055 1.2	1.081 1.067 1.4	1.470 1.448 2.3	1.125 1.106 1.8	1.169 1.156 1.2	1.123 1.118 0.6	1.469 1.468 0.1	1.081 1.085 -0.4	1.069 1.076 -0.7	1.300 1.311 -1.1	0.508 0.513 -0.5	
K	0.241 0.239 0.2	1.148 1.138 1.0	1.199 1.188 1.1	1.123 1.112 1.1	1.469 1.455 1.4	1.023 1.011 1.3	1.285 1.270 1.5	1.300 1.290 1.0	1.284 1.279 0.4	1.024 1.025 -0.1	1.471 1.477 -0.6	1.125 1.134 -0.9	1.204 1.217 -1.4	1.153 1.162 -1.0	0.241 0.243 -0.2
J	0.340 0.337 0.2	1.294 1.284 1.0	1.051 1.043 0.8	1.464 1.453 1.2	1.123 1.112 1.1	1.283 1.262 2.0	1.352 1.337 1.5	1.355 1.348 0.7	1.355 1.354 0.1	1.286 1.289 -0.3	1.125 1.131 -0.5	1.467 1.477 -0.9	1.060 1.068 -0.8	1.301 1.309 -0.8	0.341 0.342 -0.1
H	0.392 0.390 0.3	1.094 1.086 0.7	1.476 1.467 0.9	1.021 1.015 0.6	1.168 1.160 0.9	1.299 1.287 1.2	1.354 1.345 0.9	1.052 1.050 0.2	1.360 1.363 -0.3	1.302 1.308 -0.7	1.169 1.176 -0.6	1.022 1.028 -0.6	1.477 1.485 -0.8	1.094 1.098 -0.4	0.393 0.391 0.2
G	0.341 0.339 0.2	1.301 1.292 0.9	1.059 1.054 0.5	1.466 1.461 0.5	1.125 1.121 0.4	1.285 1.281 0.4	1.354 1.351 0.2	1.358 1.360 -0.2	1.357 1.364 -0.7	1.285 1.295 -1.0	1.124 1.128 -0.4	1.465 1.473 -0.8	1.051 1.058 -0.7	1.294 1.301 -0.7	0.340 0.341 -0.1
F	0.241 0.240 0.1	1.152 1.148 0.5	1.203 1.201 0.2	1.125 1.124 0.1	1.471 1.471 0.0	1.024 1.025 -0.1	1.284 1.286 -0.3	1.301 1.306 -0.5	1.287 1.294 -0.7	1.024 1.029 -0.5	1.470 1.472 -0.2	1.123 1.130 -0.7	1.199 1.210 -1.0	1.148 1.157 -0.9	0.241 0.243 -0.2
E		0.508 0.507 0.0	1.300 1.301 -0.1	1.069 1.071 -0.3	1.081 1.085 -0.4	1.469 1.476 -0.7	1.124 1.129 -0.6	1.169 1.176 -0.7	1.125 1.135 -0.9	1.471 1.483 -1.2	1.082 1.090 -0.8	1.068 1.078 -1.1	1.297 1.315 -1.8	0.507 0.513 -0.6	
D		0.197 0.197 0.0	0.748 0.750 -0.3	1.320 1.327 -0.7	1.068 1.076 -0.9	1.123 1.133 -0.9	1.465 1.476 -1.1	1.022 1.028 -0.7	1.467 1.482 -1.5	1.125 1.137 -1.2	1.069 1.081 -1.2	1.320 1.340 -1.9	0.747 0.762 -1.6	0.196 0.199 -0.3	
C			0.253 0.254 -0.1	0.747 0.753 -0.6	1.297 1.311 -1.4	1.199 1.213 -1.4	1.051 1.063 -1.2	1.477 1.485 -0.8	1.060 1.069 -0.8	1.204 1.216 -1.3	1.300 1.315 -1.5	0.748 0.758 -1.1	0.253 0.257 -0.4		
B				0.196 0.198 -0.2	0.507 0.513 -0.7	1.148 1.167 -1.9	1.294 1.317 -2.2	1.094 1.107 -1.3	1.301 1.315 -1.3	1.153 1.165 -1.2	0.508 0.514 -0.6	0.197 0.199 -0.3			
A						0.241 0.248 -0.7	0.340 0.346 -0.7	0.393 0.398 -0.5	0.341 0.345 -0.4	0.241 0.244 -0.3					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure G1 10.4.4-10: Plant G1 MOC 27 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.273 0.272 0.1	0.379 0.377 0.2	0.436 0.434 0.2	0.378 0.376 0.1	0.274 0.273 0.1					
O				0.231 0.230 0.1	0.548 0.545 0.3	1.158 1.151 0.7	1.286 1.279 0.7	1.091 1.086 0.5	1.282 1.277 0.4	1.156 1.154 0.3	0.547 0.547 0.0	0.231 0.231 0.0			
N			0.294 0.293 0.1	0.790 0.785 0.4	1.300 1.292 0.8	1.194 1.186 0.7	1.054 1.047 0.6	1.425 1.419 0.7	1.048 1.045 0.3	1.192 1.190 0.2	1.299 1.298 0.1	0.789 0.790 0.0	0.294 0.295 0.0		
M		0.231 0.230 0.1	0.789 0.786 0.4	1.316 1.308 0.8	1.076 1.070 0.6	1.114 1.106 0.8	1.419 1.406 1.3	1.021 1.016 0.5	1.419 1.416 0.3	1.114 1.114 0.0	1.076 1.077 -0.1	1.316 1.316 0.0	0.790 0.791 -0.1	0.231 0.232 -0.1	
L		0.547 0.545 0.2	1.299 1.293 0.6	1.076 1.069 0.7	1.081 1.077 0.4	1.423 1.416 0.6	1.115 1.109 0.6	1.165 1.162 0.3	1.114 1.113 0.1	1.422 1.423 -0.1	1.081 1.083 -0.2	1.076 1.079 -0.2	1.300 1.302 -0.2	0.548 0.549 -0.1	
K	0.274 0.273 0.1	1.156 1.152 0.5	1.192 1.187 0.5	1.114 1.111 0.3	1.422 1.427 -0.5	1.023 1.023 0.0	1.262 1.259 0.3	1.275 1.274 0.1	1.261 1.263 -0.2	1.024 1.026 -0.3	1.423 1.427 -0.4	1.114 1.118 -0.4	1.194 1.198 -0.4	1.158 1.158 0.0	0.273 0.273 0.0
J	0.378 0.376 0.1	1.282 1.276 0.6	1.048 1.044 0.4	1.419 1.415 0.4	1.114 1.114 0.0	1.261 1.255 0.6	1.314 1.310 0.3	1.316 1.318 -0.1	1.315 1.320 -0.5	1.263 1.269 -0.6	1.115 1.120 -0.5	1.419 1.424 -0.4	1.054 1.056 -0.2	1.286 1.283 0.3	0.379 0.376 0.2
H	0.436 0.434 0.2	1.091 1.086 0.5	1.425 1.418 0.7	1.021 1.016 0.4	1.165 1.161 0.4	1.275 1.270 0.5	1.316 1.314 0.2	1.063 1.066 -0.3	1.319 1.329 -0.9	1.276 1.288 -1.2	1.165 1.173 -0.7	1.021 1.025 -0.4	1.425 1.426 -0.1	1.091 1.087 0.4	0.436 0.430 0.6
G	0.379 0.377 0.2	1.286 1.279 0.7	1.054 1.046 0.8	1.419 1.409 1.0	1.115 1.109 0.6	1.262 1.259 0.4	1.314 1.314 0.0	1.318 1.324 -0.6	1.316 1.329 -1.3	1.261 1.279 -1.7	1.114 1.120 -0.6	1.419 1.425 -0.6	1.047 1.051 -0.3	1.282 1.282 -0.1	0.378 0.377 0.0
F	0.273 0.271 0.2	1.158 1.147 1.1	1.194 1.176 1.8	1.114 1.102 1.2	1.423 1.413 1.0	1.023 1.020 0.3	1.261 1.262 -0.1	1.276 1.282 -0.6	1.263 1.273 -1.0	1.024 1.031 -0.8	1.422 1.425 -0.3	1.114 1.120 -0.7	1.192 1.199 -0.7	1.156 1.162 -0.5	0.274 0.275 -0.1
E		0.548 0.541 0.7	1.300 1.281 2.0	1.076 1.063 1.3	1.081 1.072 0.9	1.422 1.416 0.6	1.114 1.114 -0.1	1.165 1.171 -0.6	1.115 1.126 -1.1	1.423 1.437 -1.4	1.081 1.090 -0.9	1.076 1.086 -1.0	1.299 1.314 -1.4	0.547 0.553 -0.6	
D		0.231 0.228 0.3	0.790 0.780 1.0	1.316 1.299 1.7	1.076 1.063 1.3	1.114 1.109 0.5	1.419 1.419 0.0	1.021 1.025 -0.4	1.419 1.437 -1.7	1.114 1.128 -1.4	1.076 1.088 -1.2	1.316 1.332 -1.6	0.789 0.804 -1.5	0.231 0.234 -0.4	
C			0.294 0.291 0.3	0.789 0.782 0.8	1.299 1.289 1.1	1.192 1.190 0.2	1.048 1.051 -0.3	1.425 1.427 -0.2	1.054 1.061 -0.7	1.194 1.206 -1.2	1.300 1.314 -1.4	0.790 0.800 -1.0	0.294 0.299 -0.5		
B				0.231 0.230 0.1	0.547 0.546 0.1	1.156 1.160 -0.3	1.282 1.292 -1.1	1.091 1.099 -0.7	1.286 1.295 -0.9	1.158 1.168 -1.0	0.548 0.554 -0.6	0.231 0.234 -0.3			
A						0.274 0.277 -0.3	0.378 0.382 -0.4	0.436 0.440 -0.4	0.379 0.382 -0.3	0.273 0.276 -0.3					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G1 10.4.4-11: Plant G1 EOC 27 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.312 0.311 0.1	0.423 0.421 0.1	0.487 0.485 0.1	0.422 0.422 0.0	0.313 0.314 -0.1					
O				0.276 0.274 0.1	0.595 0.592 0.3	1.163 1.158 0.5	1.271 1.266 0.5	1.093 1.089 0.4	1.269 1.266 0.3	1.162 1.162 0.0	0.595 0.595 0.0	0.276 0.276 0.0	Calculated Power Measured Power Difference (C-M)*100		
N			0.350 0.347 0.2	0.845 0.840 0.5	1.302 1.295 0.6	1.183 1.178 0.6	1.049 1.045 0.5	1.373 1.369 0.5	1.045 1.043 0.2	1.183 1.182 0.1	1.302 1.300 0.1	0.844 0.844 0.0	0.350 0.349 0.0		
M		0.276 0.274 0.2	0.844 0.837 0.7	1.338 1.330 0.8	1.088 1.084 0.4	1.104 1.099 0.5	1.367 1.358 0.9	1.017 1.014 0.3	1.367 1.365 0.2	1.104 1.104 0.0	1.088 1.088 0.0	1.338 1.337 0.2	0.844 0.844 0.1	0.276 0.276 0.0	
L		0.595 0.592 0.3	1.302 1.294 0.8	1.088 1.084 0.4	1.082 1.080 0.1	1.369 1.367 0.2	1.098 1.095 0.3	1.147 1.146 0.1	1.097 1.097 0.0	1.369 1.370 -0.1	1.081 1.082 -0.1	1.088 1.088 0.0	1.302 1.299 0.2	0.595 0.594 0.1	
K	0.314 0.312 0.2	1.162 1.156 0.6	1.183 1.178 0.5	1.105 1.103 0.1	1.369 1.377 -0.8	1.016 1.019 -0.3	1.226 1.227 -0.1	1.235 1.236 -0.2	1.225 1.228 -0.3	1.016 1.019 -0.3	1.369 1.372 -0.2	1.104 1.105 -0.1	1.183 1.182 0.1	1.163 1.160 0.3	0.312 0.311 0.1
J	0.422 0.420 0.2	1.269 1.262 0.7	1.045 1.040 0.5	1.367 1.364 0.2	1.097 1.099 -0.2	1.224 1.227 -0.3	1.259 1.262 -0.3	1.260 1.265 -0.5	1.260 1.267 -0.7	1.226 1.233 -0.7	1.098 1.102 -0.5	1.367 1.369 -0.2	1.049 1.049 0.0	1.271 1.267 0.5	0.423 0.419 0.4
H	0.487 0.483 0.4	1.093 1.085 0.8	1.373 1.364 0.9	1.017 1.012 0.5	1.147 1.145 0.2	1.235 1.235 0.0	1.260 1.263 -0.3	1.045 1.051 -0.6	1.262 1.273 -1.1	1.235 1.248 -1.3	1.147 1.155 -0.8	1.017 1.020 -0.4	1.373 1.373 0.0	1.093 1.087 0.6	0.487 0.479 0.8
G	0.423 0.419 0.4	1.271 1.259 1.2	1.049 1.039 1.1	1.367 1.356 1.1	1.098 1.092 0.5	1.226 1.224 0.2	1.260 1.262 -0.3	1.262 1.269 -0.8	1.261 1.275 -1.4	1.225 1.244 -2.0	1.097 1.106 -0.9	1.367 1.374 -0.7	1.045 1.048 -0.3	1.269 1.268 0.1	0.422 0.421 0.1
F	0.312 0.309 0.4	1.163 1.147 1.6	1.184 1.163 2.1	1.104 1.090 1.4	1.369 1.358 1.1	1.016 1.012 0.3	1.225 1.226 -0.2	1.235 1.242 -0.7	1.226 1.238 -1.2	1.016 1.027 -1.1	1.369 1.379 -1.0	1.104 1.112 -0.7	1.183 1.189 -0.7	1.162 1.166 -0.4	0.313 0.314 -0.1
E		0.595 0.586 0.9	1.302 1.279 2.3	1.088 1.072 1.6	1.081 1.069 1.2	1.369 1.361 0.8	1.097 1.097 0.0	1.147 1.154 -0.7	1.098 1.110 -1.2	1.369 1.385 -1.6	1.081 1.092 -1.0	1.088 1.097 -1.0	1.302 1.314 -1.3	0.595 0.600 -0.5	
D		0.276 0.272 0.4	0.844 0.831 1.3	1.338 1.317 2.1	1.088 1.069 1.9	1.104 1.095 0.9	1.367 1.367 0.0	1.017 1.023 -0.6	1.367 1.386 -1.9	1.104 1.119 -1.4	1.088 1.101 -1.3	1.338 1.355 -1.6	0.844 0.858 -1.3	0.276 0.279 -0.4	
C			0.350 0.345 0.5	0.844 0.832 1.2	1.302 1.284 1.8	1.183 1.176 0.7	1.045 1.047 -0.2	1.373 1.382 -0.8	1.049 1.060 -1.0	1.184 1.197 -1.3	1.302 1.316 -1.5	0.844 0.855 -1.1	0.350 0.355 -0.5		
B				0.276 0.273 0.3	0.595 0.590 0.4	1.162 1.160 0.2	1.269 1.276 -0.7	1.093 1.102 -0.8	1.271 1.283 -1.1	1.163 1.175 -1.2	0.595 0.602 -0.7	0.276 0.279 -0.4			
A						0.313 0.315 -0.1	0.422 0.425 -0.3	0.487 0.491 -0.4	0.423 0.427 -0.4	0.312 0.316 -0.3					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure G1 10.4.4-12: Plant G1 BOC 28 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.273 0.269 0.4	0.392 0.386 0.6	0.442 0.435 0.7	0.394 0.390 0.5	0.287 0.287 0.0					
O				0.308 0.305 0.3	0.527 0.521 0.6	1.173 1.157 1.6	1.289 1.270 2.0	1.425 1.400 2.5	1.293 1.270 2.2	1.178 1.168 1.0	0.529 0.526 0.2	0.309 0.308 0.1	Calculated Power Measured Power Difference (C-M)*100		
N			0.393 0.390 0.3	1.172 1.161 1.2	1.411 1.395 1.7	1.068 1.054 1.5	1.262 1.243 1.9	0.997 0.982 1.5	1.262 1.246 1.7	1.070 1.062 0.8	1.413 1.407 0.6	1.173 1.171 0.2	0.393 0.394 -0.1		
M		0.309 0.306 0.2	1.173 1.165 0.8	1.091 1.082 1.0	1.021 1.010 1.1	1.299 1.281 1.8	1.168 1.147 2.0	0.953 0.942 1.2	1.168 1.158 1.0	1.299 1.292 0.7	1.022 1.021 0.1	1.091 1.092 -0.1	1.172 1.176 -0.3	0.308 0.310 -0.2	
L		0.529 0.524 0.4	1.413 1.402 1.1	1.022 1.012 1.0	1.206 1.197 0.9	1.171 1.160 1.1	1.380 1.364 1.7	1.027 1.019 0.9	1.380 1.371 0.8	1.172 1.169 0.3	1.206 1.207 -0.1	1.021 1.025 -0.4	1.411 1.419 -0.7	0.527 0.531 -0.4	
K	0.287 0.284 0.3	1.178 1.166 1.2	1.070 1.061 0.9	1.299 1.292 0.7	1.172 1.176 -0.4	0.975 0.972 0.2	1.027 1.020 0.7	1.174 1.168 0.6	1.026 1.024 0.3	0.975 0.976 0.0	1.171 1.176 -0.4	1.299 1.307 -0.8	1.068 1.079 -1.0	1.173 1.182 -0.8	0.273 0.275 -0.2
J	0.394 0.389 0.6	1.293 1.277 1.6	1.262 1.251 1.2	1.168 1.162 0.6	1.380 1.378 0.2	1.026 1.019 0.7	1.452 1.443 0.9	0.995 0.992 0.3	1.453 1.452 0.1	1.028 1.030 -0.3	1.381 1.387 -0.7	1.168 1.176 -0.9	1.262 1.272 -1.0	1.290 1.299 -0.9	0.392 0.395 -0.3
H	0.442 0.431 1.1	1.425 1.402 2.3	0.997 0.987 1.0	0.954 0.947 0.6	1.028 1.023 0.4	1.174 1.168 0.6	0.995 0.991 0.4	0.787 0.787 0.0	0.997 0.999 -0.2	1.175 1.180 -0.5	1.028 1.036 -0.8	0.953 0.962 -0.9	0.997 1.006 -0.9	1.425 1.434 -0.9	0.442 0.444 -0.2
G	0.392 0.385 0.7	1.290 1.271 1.8	1.262 1.249 1.4	1.168 1.159 0.9	1.381 1.374 0.7	1.028 1.025 0.3	1.454 1.452 0.2	0.997 0.999 -0.2	1.455 1.460 -0.5	1.027 1.034 -0.7	1.380 1.396 -1.6	1.168 1.182 -1.4	1.262 1.276 -1.4	1.293 1.306 -1.3	0.394 0.398 -0.4
F	0.273 0.269 0.4	1.173 1.160 1.4	1.068 1.056 1.2	1.299 1.289 1.0	1.171 1.167 0.4	0.975 0.974 0.1	1.027 1.028 -0.1	1.175 1.180 -0.4	1.028 1.035 -0.7	0.976 0.987 -1.1	1.172 1.191 -1.9	1.299 1.317 -1.8	1.070 1.086 -1.6	1.178 1.194 -1.6	0.287 0.291 -0.4
E		0.527 0.522 0.5	1.411 1.399 1.2	1.021 1.016 0.5	1.206 1.204 0.2	1.172 1.173 -0.1	1.380 1.384 -0.4	1.028 1.033 -0.6	1.381 1.391 -1.0	1.172 1.185 -1.3	1.206 1.222 -1.6	1.022 1.037 -1.5	1.413 1.440 -2.7	0.529 0.538 -1.0	
D		0.308 0.306 0.2	1.172 1.166 0.6	1.091 1.088 0.3	1.022 1.023 -0.1	1.299 1.303 -0.4	1.168 1.173 -0.6	0.953 0.959 -0.5	1.168 1.178 -1.0	1.299 1.313 -1.4	1.021 1.036 -1.5	1.091 1.112 -2.1	1.173 1.203 -3.0	0.309 0.316 -0.7	
C			0.393 0.392 0.1	1.173 1.173 0.0	1.413 1.416 -0.3	1.070 1.077 -0.7	1.262 1.272 -1.0	0.997 1.003 -0.6	1.262 1.272 -1.0	1.069 1.081 -1.2	1.411 1.431 -1.9	1.172 1.193 -2.0	0.393 0.401 -0.8		
B				0.309 0.309 -0.1	0.529 0.532 -0.3	1.178 1.190 -1.2	1.293 1.309 -1.6	1.425 1.439 -1.4	1.290 1.302 -1.2	1.174 1.186 -1.3	0.527 0.534 -0.7	0.308 0.313 -0.5			
A						0.287 0.292 -0.5	0.394 0.400 -0.6	0.442 0.447 -0.5	0.392 0.396 -0.4	0.273 0.276 -0.3					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure G1 10.4.4-13: Plant G1 MOC 28 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.307 0.305 0.2	0.439 0.435 0.4	0.487 0.482 0.5	0.441 0.437 0.4	0.319 0.318 0.0					
O				0.315 0.314 0.1	0.532 0.530 0.3	1.171 1.163 0.9	1.358 1.345 1.3	1.421 1.404 1.7	1.359 1.341 1.8	1.173 1.162 1.1	0.533 0.528 0.5	0.315 0.312 0.3			
N			0.393 0.392 0.0	1.094 1.092 0.3	1.311 1.305 0.6	1.046 1.039 0.7	1.256 1.245 1.1	1.017 1.006 1.1	1.255 1.240 1.5	1.046 1.035 1.1	1.312 1.296 1.5	1.094 1.083 1.2	0.393 0.389 0.4		
M		0.315 0.315 0.0	1.094 1.096 -0.1	1.026 1.025 0.1	0.984 0.981 0.3	1.261 1.254 0.7	1.174 1.164 1.0	0.991 0.983 0.8	1.174 1.164 1.0	1.261 1.249 1.2	0.984 0.973 1.1	1.026 1.016 1.1	1.094 1.083 1.1	0.315 0.312 0.3	
L		0.533 0.532 0.0	1.312 1.311 0.0	0.984 0.983 0.1	1.172 1.171 0.1	1.167 1.164 0.4	1.470 1.461 0.8	1.074 1.069 0.6	1.469 1.459 1.0	1.168 1.160 0.8	1.173 1.164 0.9	0.984 0.976 0.8	1.311 1.298 1.3	0.532 0.528 0.4	
K	0.319 0.318 0.1	1.173 1.169 0.3	1.046 1.045 0.1	1.261 1.261 0.0	1.167 1.172 -0.5	0.998 0.999 -0.1	1.047 1.045 0.2	1.189 1.186 0.3	1.046 1.043 0.3	0.999 0.995 0.3	1.167 1.162 0.5	1.261 1.253 0.8	1.046 1.038 0.9	1.171 1.161 1.0	0.307 0.305 0.3
J	0.441 0.438 0.3	1.359 1.353 0.7	1.255 1.252 0.3	1.174 1.174 0.0	1.469 1.471 -0.2	1.046 1.046 0.0	1.408 1.407 0.1	0.989 0.989 0.0	1.409 1.408 0.0	1.047 1.047 0.0	1.470 1.467 0.3	1.174 1.171 0.3	1.256 1.248 0.7	1.358 1.347 1.1	0.439 0.434 0.5
H	0.487 0.480 0.6	1.421 1.410 1.1	1.017 1.013 0.4	0.991 0.990 0.1	1.074 1.075 0.0	1.189 1.190 0.0	0.989 0.990 -0.1	0.806 0.808 -0.2	0.991 0.994 -0.4	1.190 1.194 -0.5	1.075 1.079 -0.4	0.991 0.992 -0.1	1.017 1.014 0.2	1.420 1.407 1.3	0.487 0.478 0.9
G	0.439 0.435 0.4	1.358 1.349 0.9	1.256 1.250 0.6	1.174 1.172 0.3	1.470 1.469 0.1	1.047 1.048 -0.1	1.409 1.413 -0.4	0.991 0.996 -0.5	1.410 1.419 -0.9	1.046 1.056 -1.0	1.469 1.483 -1.4	1.174 1.181 -0.7	1.255 1.257 -0.2	1.359 1.356 0.4	0.441 0.439 0.2
F	0.307 0.305 0.2	1.171 1.165 0.7	1.046 1.040 0.6	1.261 1.257 0.4	1.168 1.167 0.0	0.999 1.001 -0.2	1.046 1.051 -0.4	1.190 1.197 -0.7	1.047 1.056 -0.9	0.999 1.012 -1.3	1.168 1.186 -1.9	1.261 1.272 -1.1	1.046 1.053 -0.7	1.173 1.176 -0.4	0.319 0.319 -0.1
E		0.532 0.530 0.2	1.311 1.305 0.6	0.984 0.981 0.2	1.173 1.172 0.0	1.168 1.171 -0.3	1.469 1.476 -0.7	1.075 1.083 -0.8	1.470 1.483 -1.3	1.168 1.181 -1.4	1.173 1.186 -1.4	0.984 0.994 -0.9	1.312 1.327 -1.5	0.533 0.538 -0.5	
D		0.315 0.314 0.1	1.094 1.091 0.3	1.026 1.024 0.2	0.984 0.983 0.1	1.261 1.265 -0.4	1.174 1.182 -0.8	0.991 0.999 -0.9	1.174 1.187 -1.3	1.261 1.276 -1.5	0.984 0.996 -1.3	1.026 1.041 -1.5	1.094 1.115 -2.0	0.315 0.320 -0.5	
C			0.393 0.392 0.0	1.094 1.094 0.0	1.312 1.313 -0.1	1.046 1.052 -0.6	1.255 1.267 -1.2	1.017 1.027 -1.1	1.256 1.269 -1.3	1.046 1.059 -1.3	1.311 1.328 -1.7	1.094 1.110 -1.6	0.393 0.399 -0.7		
B				0.315 0.316 -0.1	0.533 0.535 -0.3	1.173 1.182 -1.0	1.359 1.377 -1.8	1.420 1.438 -1.7	1.358 1.374 -1.6	1.171 1.185 -1.4	0.532 0.539 -0.7	0.315 0.320 -0.5			
A						0.319 0.322 -0.3	0.441 0.446 -0.6	0.487 0.493 -0.6	0.439 0.445 -0.6	0.307 0.311 -0.4					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure G1 10.4.4-14: Plant G1 EOC 28 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.341 0.338 0.3	0.477 0.472 0.5	0.520 0.514 0.6	0.478 0.473 0.5	0.352 0.350 0.2					
O				0.347 0.346 0.1	0.563 0.560 0.3	1.166 1.156 1.0	1.352 1.337 1.4	1.375 1.357 1.7	1.352 1.333 1.9	1.166 1.156 1.0	0.563 0.560 0.4	0.347 0.346 0.2			
N			0.428 0.427 0.1	1.101 1.097 0.4	1.287 1.280 0.7	1.040 1.032 0.8	1.230 1.217 1.3	1.013 1.003 1.1	1.229 1.216 1.3	1.040 1.032 0.8	1.287 1.280 0.8	1.101 1.096 0.5	0.428 0.426 0.1		
M		0.347 0.347 0.0	1.101 1.100 0.0	1.042 1.040 0.2	0.991 0.988 0.3	1.236 1.227 1.0	1.155 1.141 1.4	0.999 0.990 0.8	1.155 1.147 0.8	1.236 1.230 0.6	0.991 0.988 0.4	1.042 1.038 0.4	1.101 1.097 0.4	0.347 0.347 0.1	
L		0.563 0.563 0.0	1.287 1.288 0.0	0.991 0.993 -0.2	1.166 1.167 -0.1	1.152 1.148 0.4	1.450 1.441 1.0	1.075 1.069 0.5	1.450 1.444 0.6	1.152 1.149 0.3	1.166 1.164 0.2	0.991 0.990 0.2	1.287 1.284 0.4	0.563 0.562 0.1	
K	0.352 0.351 0.0	1.166 1.165 0.1	1.040 1.041 -0.1	1.236 1.240 -0.4	1.152 1.161 -0.9	1.005 1.008 -0.3	1.046 1.044 0.1	1.180 1.178 0.1	1.045 1.045 0.0	1.005 1.006 -0.1	1.152 1.152 -0.1	1.236 1.236 0.0	1.040 1.039 0.1	1.166 1.163 0.3	0.341 0.340 0.1
J	0.478 0.476 0.2	1.352 1.348 0.3	1.229 1.228 0.1	1.155 1.157 -0.2	1.450 1.456 -0.7	1.045 1.047 -0.3	1.369 1.371 -0.2	0.991 0.993 -0.2	1.370 1.374 -0.5	1.046 1.051 -0.5	1.450 1.456 -0.5	1.155 1.158 -0.3	1.230 1.229 0.1	1.351 1.347 0.5	0.477 0.474 0.3
H	0.520 0.516 0.4	1.375 1.368 0.7	1.014 1.011 0.2	0.999 0.999 0.0	1.075 1.077 -0.2	1.180 1.182 -0.2	0.991 0.994 -0.3	0.832 0.837 -0.4	0.992 1.000 -0.8	1.180 1.192 -1.2	1.075 1.084 -0.9	0.999 1.004 -0.5	1.013 1.015 -0.1	1.375 1.369 0.6	0.520 0.514 0.5
G	0.477 0.474 0.3	1.351 1.342 0.9	1.230 1.225 0.5	1.155 1.154 0.1	1.450 1.451 0.0	1.046 1.048 -0.2	1.370 1.374 -0.5	0.992 0.999 -0.6	1.370 1.385 -1.5	1.045 1.063 -1.8	1.450 1.469 -1.9	1.155 1.164 -1.0	1.229 1.234 -0.4	1.352 1.352 0.0	0.478 0.477 0.1
F	0.341 0.340 0.2	1.166 1.160 0.6	1.040 1.036 0.4	1.236 1.234 0.2	1.152 1.151 0.0	1.005 1.007 -0.1	1.045 1.048 -0.3	1.180 1.186 -0.6	1.046 1.055 -0.9	1.005 1.019 -1.4	1.152 1.171 -1.9	1.236 1.247 -1.1	1.040 1.046 -0.6	1.166 1.170 -0.4	0.352 0.352 -0.1
E		0.563 0.561 0.2	1.287 1.283 0.4	0.991 0.989 0.2	1.166 1.165 0.1	1.152 1.152 -0.1	1.450 1.452 -0.3	1.075 1.079 -0.4	1.450 1.457 -0.6	1.152 1.160 -0.9	1.166 1.176 -1.0	0.991 0.998 -0.6	1.287 1.296 -0.9	0.563 0.567 -0.4	
D		0.347 0.346 0.1	1.101 1.098 0.3	1.042 1.039 0.3	0.991 0.989 0.2	1.236 1.235 0.1	1.155 1.156 -0.2	0.999 1.002 -0.3	1.155 1.157 -0.2	1.236 1.241 -0.5	0.991 0.998 -0.7	1.042 1.049 -0.8	1.101 1.111 -1.0	0.347 0.350 -0.3	
C			0.427 0.426 0.1	1.101 1.098 0.3	1.287 1.284 0.4	1.040 1.039 0.1	1.229 1.230 -0.1	1.013 1.017 -0.4	1.230 1.234 -0.4	1.040 1.045 -0.4	1.287 1.294 -0.7	1.101 1.108 -0.7	0.427 0.431 -0.4		
B				0.347 0.347 0.1	0.563 0.562 0.1	1.166 1.164 0.3	1.352 1.351 0.0	1.375 1.377 -0.2	1.351 1.355 -0.4	1.166 1.171 -0.5	0.563 0.566 -0.3	0.347 0.350 -0.2			
A						0.352 0.350 0.1	0.478 0.477 0.0	0.520 0.521 -0.1	0.477 0.478 -0.2	0.341 0.343 -0.1					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure G1 10.4.4-15: Plant G1 BOC 29 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.236 0.235 0.1	0.343 0.341 0.2	0.377 0.373 0.4	0.344 0.339 0.4	0.236 0.233 0.3					
O				0.266 0.264 0.2	0.497 0.495 0.2	1.100 1.095 0.5	1.226 1.219 0.7	1.312 1.299 1.3	1.228 1.210 1.8	1.100 1.091 0.9	0.497 0.495 0.2	0.266 0.266 0.0			
N			0.348 0.344 0.3	1.086 1.079 0.8	1.259 1.253 0.6	1.045 1.043 0.3	1.246 1.242 0.4	1.080 1.074 0.6	1.247 1.238 0.9	1.045 1.041 0.4	1.258 1.256 0.2	1.085 1.085 0.0	0.348 0.348 -0.1		
M		0.266 0.263 0.3	1.085 1.070 1.5	1.014 1.005 0.9	1.357 1.352 0.5	1.274 1.274 -0.1	1.284 1.287 -0.3	1.225 1.225 0.0	1.284 1.283 0.1	1.274 1.275 -0.1	1.357 1.359 -0.2	1.014 1.015 -0.1	1.086 1.089 -0.2	0.266 0.267 -0.1	
L		0.497 0.493 0.4	1.258 1.246 1.3	1.358 1.343 1.4	1.331 1.329 0.2	1.257 1.262 -0.5	1.019 1.025 -0.6	1.171 1.177 -0.5	1.019 1.023 -0.4	1.257 1.261 -0.5	1.330 1.335 -0.4	1.356 1.361 -0.5	1.258 1.262 -0.4	0.497 0.499 -0.2	
K	0.236 0.235 0.1	1.101 1.096 0.5	1.046 1.042 0.4	1.275 1.273 0.2	1.258 1.271 -1.3	0.972 0.983 -1.1	1.352 1.365 -1.3	0.975 0.983 -0.8	1.354 1.363 -1.0	0.972 0.979 -0.7	1.256 1.264 -0.8	1.273 1.280 -0.7	1.045 1.051 -0.6	1.100 1.101 -0.1	0.236 0.236 -0.1
J	0.344 0.343 0.1	1.228 1.225 0.3	1.248 1.247 0.1	1.284 1.288 -0.4	1.020 1.030 -1.1	1.355 1.376 -2.1	1.047 1.060 -1.3	1.456 1.471 -1.5	1.045 1.056 -1.1	1.353 1.366 -1.3	1.019 1.027 -0.8	1.283 1.291 -0.8	1.245 1.248 -0.3	1.226 1.226 0.0	0.343 0.344 -0.1
H	0.377 0.374 0.2	1.312 1.309 0.4	1.080 1.081 -0.1	1.226 1.230 -0.4	1.172 1.181 -0.9	0.976 0.987 -1.1	1.460 1.475 -1.6	1.001 1.011 -1.1	1.456 1.474 -1.8	0.975 0.989 -1.4	1.171 1.183 -1.2	1.225 1.233 -0.8	1.080 1.085 -0.5	1.312 1.313 -0.2	0.376 0.377 -0.1
G	0.343 0.343 0.1	1.227 1.225 0.1	1.246 1.247 -0.1	1.284 1.288 -0.4	1.020 1.025 -0.5	1.354 1.363 -0.9	1.048 1.055 -0.8	1.459 1.471 -1.2	1.046 1.059 -1.3	1.354 1.378 -2.4	1.019 1.030 -1.1	1.283 1.292 -0.9	1.247 1.254 -0.7	1.228 1.233 -0.5	0.344 0.345 -0.2
F	0.236 0.236 0.0	1.100 1.100 -0.1	1.045 1.047 -0.2	1.274 1.277 -0.3	1.257 1.260 -0.4	0.972 0.975 -0.3	1.355 1.358 -0.3	0.976 0.978 -0.2	1.353 1.359 -0.6	0.972 0.979 -0.7	1.256 1.265 -0.9	1.273 1.280 -0.6	1.045 1.052 -0.7	1.100 1.107 -0.7	0.236 0.237 -0.2
E		0.497 0.498 -0.1	1.258 1.259 -0.1	1.357 1.359 -0.2	1.331 1.332 -0.2	1.257 1.256 0.1	1.019 1.015 0.4	1.172 1.164 0.7	1.019 1.013 0.6	1.256 1.253 0.3	1.329 1.330 0.0	1.356 1.360 -0.4	1.257 1.270 -1.3	0.496 0.502 -0.5	
D		0.266 0.266 0.0	1.086 1.087 -0.1	1.014 1.014 -0.1	1.357 1.361 -0.4	1.274 1.270 0.4	1.284 1.269 1.5	1.225 1.203 2.3	1.283 1.261 2.2	1.272 1.261 1.1	1.354 1.351 0.3	1.012 1.018 -0.6	1.083 1.103 -2.0	0.265 0.269 -0.4	
C			0.347 0.348 0.0	1.085 1.084 0.1	1.258 1.255 0.3	1.045 1.036 1.0	1.247 1.222 2.6	1.080 1.048 3.2	1.245 1.217 2.8	1.044 1.031 1.3	1.255 1.248 0.7	1.081 1.083 -0.2	0.346 0.350 -0.3		
B				0.266 0.265 0.1	0.497 0.494 0.3	1.100 1.085 1.5	1.228 1.195 3.3	1.312 1.275 3.6	1.226 1.198 2.7	1.098 1.081 1.7	0.495 0.491 0.4	0.262 0.262 0.0			
A						0.236 0.233 0.2	0.344 0.336 0.7	0.376 0.367 0.9	0.343 0.336 0.7	0.236 0.232 0.4					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure G1 10.4.4-16: Plant G1 MOC 29 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.267 0.266 0.1	0.380 0.377 0.2	0.409 0.406 0.4	0.382 0.377 0.4	0.268 0.265 0.3					
O				0.295 0.295 0.0	0.535 0.534 0.1	1.112 1.108 0.4	1.264 1.257 0.7	1.291 1.279 1.2	1.274 1.257 1.7	1.119 1.107 1.2	0.537 0.532 0.5	0.296 0.294 0.2			
N			0.374 0.374 0.0	1.097 1.097 0.0	1.306 1.304 0.1	1.032 1.031 0.2	1.189 1.184 0.5	1.050 1.043 0.7	1.212 1.202 1.1	1.040 1.031 0.9	1.309 1.297 1.2	1.098 1.090 0.8	0.374 0.372 0.2		
M		0.296 0.296 0.0	1.098 1.098 0.0	1.019 1.019 0.0	1.297 1.298 -0.1	1.210 1.211 -0.1	1.219 1.218 0.1	1.176 1.173 0.3	1.225 1.220 0.5	1.216 1.208 0.7	1.300 1.289 1.0	1.019 1.013 0.6	1.098 1.091 0.6	0.295 0.294 0.1	
L		0.537 0.536 0.1	1.309 1.307 0.2	1.300 1.298 0.2	1.260 1.263 -0.3	1.209 1.215 -0.6	1.020 1.024 -0.4	1.159 1.161 -0.2	1.021 1.021 0.0	1.211 1.208 0.3	1.260 1.255 0.5	1.297 1.291 0.6	1.306 1.299 0.7	0.535 0.533 0.2	
K	0.268 0.267 0.1	1.119 1.115 0.4	1.040 1.038 0.2	1.216 1.218 -0.2	1.212 1.224 -1.3	0.991 1.003 -1.2	1.426 1.438 -1.3	1.004 1.010 -0.6	1.427 1.432 -0.5	0.991 0.993 -0.2	1.209 1.208 0.1	1.210 1.207 0.3	1.032 1.029 0.3	1.112 1.108 0.4	0.267 0.266 0.1
J	0.382 0.378 0.3	1.274 1.265 0.9	1.213 1.209 0.4	1.225 1.228 -0.3	1.021 1.032 -1.1	1.428 1.455 -2.7	1.060 1.075 -1.4	1.417 1.429 -1.3	1.059 1.067 -0.7	1.426 1.433 -0.6	1.020 1.022 -0.2	1.219 1.218 0.1	1.189 1.185 0.4	1.264 1.260 0.4	0.380 0.379 0.1
H	0.409 0.402 0.8	1.291 1.276 1.5	1.050 1.044 0.6	1.176 1.176 0.1	1.159 1.166 -0.7	1.005 1.017 -1.2	1.419 1.435 -1.7	0.990 1.000 -1.0	1.417 1.430 -1.3	1.004 1.013 -0.8	1.159 1.163 -0.4	1.176 1.175 0.0	1.050 1.048 0.2	1.291 1.286 0.5	0.409 0.408 0.1
G	0.380 0.374 0.6	1.264 1.247 1.7	1.189 1.177 1.2	1.219 1.214 0.5	1.020 1.022 -0.2	1.427 1.436 -0.9	1.061 1.070 -0.9	1.418 1.431 -1.3	1.060 1.071 -1.1	1.428 1.444 -1.6	1.021 1.024 -0.3	1.225 1.224 0.1	1.213 1.210 0.2	1.274 1.270 0.3	0.382 0.381 0.1
F	0.267 0.263 0.4	1.112 1.097 1.5	1.032 1.018 1.4	1.210 1.201 0.9	1.209 1.208 0.2	0.991 0.995 -0.3	1.428 1.436 -0.8	1.005 1.013 -0.8	1.427 1.439 -1.2	0.991 0.997 -0.6	1.211 1.209 0.2	1.216 1.210 0.5	1.040 1.038 0.2	1.119 1.118 0.2	0.268 0.268 0.0
E		0.535 0.529 0.6	1.306 1.290 1.6	1.297 1.287 1.0	1.260 1.255 0.4	1.211 1.212 -0.1	1.021 1.026 -0.4	1.159 1.167 -0.8	1.020 1.030 -1.0	1.209 1.216 -0.7	1.260 1.257 0.2	1.299 1.290 0.9	1.309 1.309 -0.1	0.537 0.538 -0.1	
D		0.295 0.293 0.3	1.097 1.088 1.0	1.019 1.012 0.7	1.300 1.294 0.6	1.216 1.215 0.1	1.225 1.228 -0.3	1.176 1.182 -0.6	1.219 1.233 -1.4	1.210 1.219 -0.9	1.296 1.300 -0.4	1.018 1.021 -0.3	1.097 1.106 -0.9	0.296 0.297 -0.2	
C			0.374 0.372 0.2	1.098 1.092 0.6	1.309 1.304 0.5	1.040 1.040 0.0	1.213 1.214 -0.2	1.050 1.053 -0.3	1.189 1.195 -0.6	1.032 1.038 -0.6	1.304 1.309 -0.5	1.094 1.099 -0.5	0.373 0.376 -0.2		
B				0.296 0.295 0.1	0.537 0.537 0.0	1.119 1.123 -0.4	1.274 1.276 -0.3	1.291 1.294 -0.3	1.264 1.269 -0.5	1.111 1.117 -0.5	0.534 0.537 -0.3	0.292 0.294 -0.2			
A						0.268 0.272 -0.4	0.382 0.384 -0.3	0.409 0.411 -0.2	0.380 0.381 -0.2	0.266 0.268 -0.1					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G1 10.4.4-17: Plant G1 EOC 29 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.311 0.309 0.3	0.430 0.426 0.4	0.455 0.450 0.6	0.432 0.425 0.6	0.312 0.308 0.5					
O				0.336 0.334 0.2	0.584 0.580 0.4	1.131 1.121 1.0	1.288 1.274 1.3	1.272 1.256 1.7	1.293 1.272 2.1	1.135 1.122 1.3	0.585 0.581 0.4	0.337 0.335 0.2			
N			0.413 0.410 0.2	1.105 1.098 0.8	1.318 1.308 1.0	1.036 1.029 0.8	1.173 1.163 1.0	1.043 1.033 1.0	1.190 1.177 1.3	1.041 1.033 0.8	1.320 1.313 0.7	1.106 1.101 0.4	0.413 0.412 0.1		
M		0.337 0.335 0.2	1.106 1.099 0.6	1.014 1.007 0.7	1.250 1.241 0.9	1.176 1.169 0.7	1.189 1.184 0.6	1.153 1.147 0.7	1.193 1.186 0.6	1.179 1.175 0.4	1.252 1.249 0.3	1.014 1.012 0.2	1.105 1.103 0.2	0.336 0.336 0.0	
L		0.585 0.582 0.4	1.320 1.310 1.0	1.252 1.239 1.3	1.211 1.202 1.0	1.177 1.172 0.5	1.019 1.016 0.3	1.145 1.142 0.3	1.020 1.018 0.2	1.178 1.177 0.1	1.211 1.210 0.1	1.250 1.250 0.1	1.318 1.315 0.2	0.584 0.583 0.1	
K	0.312 0.310 0.2	1.135 1.127 0.8	1.041 1.033 0.7	1.179 1.170 0.9	1.179 1.172 0.7	0.993 0.991 0.3	1.408 1.407 0.2	1.004 1.004 0.0	1.410 1.411 -0.2	0.993 0.995 -0.2	1.177 1.179 -0.2	1.176 1.177 -0.1	1.036 1.036 0.0	1.131 1.125 0.6	0.311 0.310 0.1
J	0.432 0.428 0.3	1.293 1.284 0.9	1.189 1.182 0.7	1.193 1.187 0.6	1.020 1.017 0.3	1.410 1.408 0.2	1.043 1.044 -0.1	1.345 1.349 -0.4	1.043 1.048 -0.5	1.409 1.416 -0.7	1.019 1.024 -0.4	1.189 1.191 -0.2	1.173 1.169 0.4	1.288 1.278 1.0	0.430 0.428 0.3
H	0.455 0.451 0.5	1.272 1.263 1.0	1.043 1.038 0.5	1.153 1.149 0.4	1.145 1.143 0.2	1.004 1.005 -0.1	1.346 1.349 -0.4	0.971 0.977 -0.6	1.345 1.357 -1.3	1.004 1.016 -1.2	1.145 1.153 -0.9	1.153 1.157 -0.4	1.043 1.044 0.0	1.272 1.268 0.5	0.455 0.453 0.2
G	0.430 0.428 0.3	1.287 1.282 0.6	1.173 1.168 0.5	1.189 1.186 0.3	1.019 1.019 0.1	1.409 1.411 -0.2	1.044 1.048 -0.4	1.346 1.355 -1.0	1.043 1.057 -1.4	1.410 1.434 -2.5	1.020 1.029 -0.9	1.193 1.199 -0.6	1.190 1.193 -0.3	1.293 1.294 -0.1	0.432 0.432 0.0
F	0.311 0.310 0.1	1.131 1.127 0.4	1.036 1.032 0.5	1.176 1.173 0.3	1.177 1.177 0.0	0.993 0.995 -0.2	1.410 1.415 -0.6	1.004 1.012 -0.7	1.409 1.424 -1.5	0.993 1.005 -1.1	1.178 1.187 -0.9	1.179 1.185 -0.6	1.041 1.047 -0.7	1.136 1.141 -0.6	0.312 0.314 -0.1
E		0.584 0.582 0.2	1.318 1.313 0.5	1.250 1.248 0.3	1.211 1.211 0.0	1.178 1.180 -0.2	1.020 1.024 -0.4	1.145 1.153 -0.8	1.020 1.030 -1.1	1.177 1.189 -1.2	1.211 1.220 -0.9	1.252 1.260 -0.7	1.320 1.335 -1.5	0.585 0.592 -0.6	
D		0.336 0.336 0.1	1.105 1.103 0.3	1.014 1.013 0.1	1.252 1.252 0.0	1.179 1.181 -0.2	1.193 1.196 -0.3	1.153 1.159 -0.6	1.189 1.203 -1.3	1.176 1.189 -1.3	1.250 1.263 -1.2	1.014 1.027 -1.3	1.105 1.127 -2.2	0.337 0.342 -0.5	
C			0.413 0.412 0.0	1.106 1.105 0.1	1.320 1.320 0.0	1.041 1.042 -0.2	1.190 1.191 -0.1	1.043 1.045 -0.2	1.173 1.179 -0.6	1.036 1.045 -0.9	1.317 1.330 -1.3	1.103 1.117 -1.4	0.412 0.419 -0.7		
B				0.337 0.337 0.0	0.585 0.587 -0.1	1.135 1.138 -0.3	1.293 1.293 0.0	1.272 1.274 -0.2	1.288 1.293 -0.6	1.131 1.139 -0.8	0.584 0.589 -0.6	0.334 0.338 -0.4			
A						0.312 0.315 -0.3	0.432 0.434 -0.2	0.455 0.457 -0.2	0.430 0.433 -0.2	0.311 0.313 -0.2					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G1 10.4.4-18: Plant G1 BOC 30 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.216 0.215 0.1	0.410 0.409 0.1	0.387 0.386 0.1	0.412 0.412 -0.1	0.217 0.219 -0.2					
O				0.281 0.279 0.1	0.441 0.439 0.2	0.888 0.885 0.3	1.335 1.331 0.4	1.295 1.291 0.4	1.340 1.337 0.3	0.892 0.893 -0.1	0.443 0.443 0.0	0.281 0.282 0.0	Calculated Power Measured Power Difference (C-M)*100		
N			0.373 0.371 0.2	1.168 1.162 0.6	1.351 1.344 0.7	1.210 1.205 0.5	0.998 0.995 0.3	1.025 1.023 0.2	1.013 1.011 0.2	1.216 1.215 0.1	1.355 1.353 0.2	1.170 1.171 -0.1	0.373 0.374 -0.1		
M		0.282 0.280 0.1	1.170 1.167 0.3	1.029 1.022 0.7	1.337 1.328 0.9	1.352 1.346 0.6	1.048 1.045 0.3	1.408 1.406 0.2	1.052 1.052 0.0	1.356 1.355 0.1	1.340 1.338 0.2	1.028 1.031 -0.2	1.168 1.172 -0.5	0.281 0.283 -0.2	
L		0.443 0.439 0.3	1.356 1.344 1.2	1.340 1.319 2.1	1.218 1.206 1.2	1.279 1.274 0.5	1.462 1.461 0.1	1.077 1.079 -0.1	1.466 1.468 -0.2	1.283 1.285 -0.3	1.218 1.221 -0.3	1.337 1.343 -0.6	1.351 1.359 -0.8	0.441 0.445 -0.4	
K	0.217 0.215 0.2	0.893 0.884 0.9	1.217 1.205 1.2	1.357 1.341 1.6	1.283 1.273 1.0	1.000 1.000 0.0	1.028 1.032 -0.4	1.141 1.146 -0.5	1.029 1.034 -0.5	0.999 1.004 -0.5	1.279 1.286 -0.7	1.352 1.361 -0.9	1.210 1.222 -1.2	0.888 0.897 -0.9	0.216 0.218 -0.3
J	0.412 0.407 0.5	1.341 1.326 1.5	1.013 1.004 1.0	1.052 1.045 0.7	1.466 1.463 0.3	1.029 1.041 -1.2	1.428 1.443 -1.4	1.008 1.016 -0.8	1.427 1.438 -1.1	1.027 1.035 -0.8	1.462 1.471 -0.9	1.048 1.056 -0.7	0.998 1.006 -0.8	1.335 1.350 -1.5	0.410 0.415 -0.5
H	0.387 0.381 0.6	1.295 1.278 1.7	1.025 1.016 1.0	1.408 1.400 0.8	1.077 1.077 0.1	1.140 1.149 -0.8	1.007 1.016 -0.9	0.774 0.781 -0.7	1.006 1.017 -1.1	1.140 1.152 -1.3	1.077 1.085 -0.7	1.408 1.415 -0.7	1.025 1.032 -0.7	1.295 1.304 -0.9	0.387 0.391 -0.4
G	0.410 0.404 0.6	1.335 1.318 1.7	0.998 0.988 1.0	1.048 1.042 0.6	1.462 1.458 0.4	1.027 1.030 -0.2	1.427 1.434 -0.7	1.006 1.013 -0.7	1.426 1.441 -1.5	1.028 1.042 -1.3	1.466 1.469 -0.3	1.052 1.054 -0.2	1.013 1.017 -0.4	1.340 1.347 -0.7	0.412 0.414 -0.3
F	0.216 0.213 0.3	0.888 0.877 1.0	1.210 1.196 1.4	1.352 1.341 1.1	1.279 1.274 0.5	0.999 0.999 0.0	1.029 1.031 -0.3	1.140 1.144 -0.5	1.027 1.032 -0.5	0.999 1.001 -0.2	1.282 1.276 0.6	1.356 1.352 0.4	1.217 1.218 -0.2	0.892 0.895 -0.3	0.217 0.218 -0.1
E		0.441 0.437 0.4	1.351 1.337 1.4	1.337 1.326 1.1	1.218 1.210 0.8	1.283 1.279 0.3	1.466 1.466 0.0	1.077 1.079 -0.2	1.462 1.463 -0.1	1.279 1.278 0.1	1.218 1.212 0.5	1.340 1.332 0.8	1.355 1.358 -0.3	0.443 0.445 -0.2	
D		0.281 0.278 0.3	1.168 1.157 1.1	1.028 1.020 0.9	1.340 1.326 1.3	1.356 1.351 0.6	1.052 1.053 -0.1	1.408 1.411 -0.3	1.048 1.048 0.0	1.352 1.351 0.1	1.337 1.336 0.1	1.029 1.031 -0.2	1.170 1.180 -0.9	0.281 0.283 -0.2	
C			0.373 0.370 0.3	1.170 1.162 0.8	1.355 1.346 0.9	1.217 1.217 0.0	1.013 1.019 -0.6	1.025 1.032 -0.7	0.999 1.002 -0.4	1.211 1.213 -0.2	1.352 1.354 -0.2	1.168 1.171 -0.3	0.373 0.375 -0.2		
B				0.281 0.280 0.1	0.443 0.443 0.0	0.892 0.900 -0.8	1.340 1.357 -1.7	1.295 1.307 -1.2	1.336 1.344 -0.8	0.888 0.892 -0.4	0.441 0.443 -0.1	0.281 0.282 -0.1			
A						0.217 0.223 -0.6	0.412 0.419 -0.7	0.387 0.391 -0.4	0.410 0.413 -0.3	0.216 0.217 -0.1					

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G1 10.4.4-19: Plant G1 MOC 30 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.242 0.242 0.1	0.440 0.439 0.1	0.424 0.423 0.1	0.442 0.442 0.0	0.244 0.244 -0.1					
O				0.303 0.303 0.0	0.471 0.470 0.1	0.895 0.893 0.2	1.310 1.306 0.3	1.342 1.339 0.3	1.315 1.313 0.2	0.899 0.896 0.3	0.472 0.470 0.3	0.304 0.302 0.2	Calculated Power Measured Power Difference (C-M)*100		
N			0.389 0.390 -0.1	1.145 1.144 0.0	1.366 1.363 0.3	1.179 1.175 0.4	1.003 1.000 0.3	1.051 1.047 0.3	1.020 1.016 0.4	1.186 1.178 0.7	1.370 1.358 1.2	1.147 1.138 0.8	0.389 0.387 0.2		
M		0.304 0.304 -0.1	1.147 1.153 -0.6	1.000 0.999 0.1	1.268 1.264 0.4	1.296 1.291 0.5	1.066 1.060 0.6	1.498 1.493 0.5	1.070 1.066 0.4	1.300 1.291 0.9	1.270 1.258 1.3	1.000 0.993 0.6	1.145 1.139 0.6	0.303 0.302 0.1	
L		0.473 0.471 0.1	1.370 1.367 0.3	1.270 1.260 1.0	1.160 1.155 0.5	1.238 1.236 0.2	1.521 1.518 0.3	1.112 1.110 0.2	1.524 1.521 0.3	1.241 1.237 0.4	1.160 1.154 0.5	1.268 1.262 0.6	1.366 1.360 0.6	0.471 0.470 0.1	
K	0.244 0.241 0.2	0.900 0.893 0.6	1.186 1.179 0.7	1.300 1.293 0.7	1.241 1.243 -0.1	0.998 1.002 -0.4	1.026 1.030 -0.4	1.138 1.140 -0.2	1.027 1.028 -0.1	0.998 0.997 0.0	1.238 1.237 0.2	1.296 1.293 0.3	1.179 1.177 0.2	0.895 0.896 -0.1	0.242 0.243 -0.1
J	0.442 0.436 0.6	1.315 1.301 1.5	1.020 1.012 0.8	1.070 1.067 0.3	1.524 1.528 -0.4	1.028 1.041 -1.3	1.363 1.376 -1.3	0.983 0.988 -0.5	1.363 1.368 -0.5	1.026 1.029 -0.3	1.521 1.522 -0.1	1.066 1.067 -0.1	1.003 1.004 -0.1	1.310 1.314 -0.5	0.440 0.441 -0.1
H	0.424 0.414 1.0	1.342 1.320 2.2	1.051 1.040 1.1	1.498 1.490 0.7	1.112 1.113 -0.1	1.138 1.147 -0.9	0.983 0.991 -0.8	0.784 0.790 -0.5	0.982 0.988 -0.7	1.137 1.144 -0.7	1.112 1.115 -0.3	1.498 1.500 -0.2	1.051 1.053 -0.2	1.342 1.345 -0.3	0.424 0.425 -0.1
G	0.440 0.430 0.9	1.310 1.285 2.4	1.003 0.990 1.4	1.066 1.059 0.8	1.521 1.517 0.3	1.026 1.029 -0.3	1.362 1.369 -0.7	0.981 0.988 -0.6	1.362 1.373 -1.1	1.027 1.036 -0.9	1.524 1.528 -0.4	1.070 1.072 -0.2	1.020 1.022 -0.3	1.315 1.319 -0.4	0.442 0.443 -0.2
F	0.242 0.238 0.4	0.895 0.879 1.5	1.179 1.160 1.9	1.296 1.283 1.3	1.238 1.233 0.5	0.998 0.998 0.0	1.027 1.031 -0.4	1.137 1.144 -0.6	1.026 1.032 -0.6	0.998 1.002 -0.4	1.241 1.241 0.0	1.300 1.299 0.1	1.186 1.190 -0.4	0.899 0.903 -0.4	0.244 0.245 -0.1
E		0.471 0.464 0.7	1.366 1.347 1.8	1.268 1.255 1.2	1.160 1.154 0.6	1.241 1.240 0.1	1.524 1.529 -0.5	1.112 1.118 -0.6	1.521 1.529 -0.8	1.238 1.243 -0.5	1.160 1.160 0.0	1.270 1.268 0.3	1.370 1.380 -1.1	0.473 0.477 -0.4	
D		0.303 0.300 0.3	1.145 1.133 1.2	1.000 0.992 0.8	1.270 1.260 1.0	1.300 1.298 0.2	1.070 1.076 -0.5	1.498 1.510 -1.2	1.066 1.073 -0.7	1.296 1.304 -0.8	1.268 1.275 -0.7	1.000 1.009 -0.9	1.147 1.167 -2.0	0.304 0.308 -0.4	
C			0.389 0.386 0.3	1.147 1.140 0.7	1.370 1.364 0.5	1.186 1.189 -0.4	1.020 1.030 -1.0	1.051 1.065 -1.4	1.003 1.014 -1.1	1.179 1.190 -1.0	1.366 1.377 -1.1	1.145 1.156 -1.2	0.389 0.394 -0.5		
B				0.304 0.303 0.1	0.473 0.474 -0.1	0.899 0.909 -1.0	1.315 1.336 -2.1	1.342 1.361 -1.9	1.310 1.326 -1.6	0.895 0.904 -0.9	0.471 0.476 -0.5	0.303 0.306 -0.3			
A						0.244 0.249 -0.6	0.442 0.450 -0.8	0.424 0.430 -0.6	0.440 0.446 -0.6	0.242 0.245 -0.3					

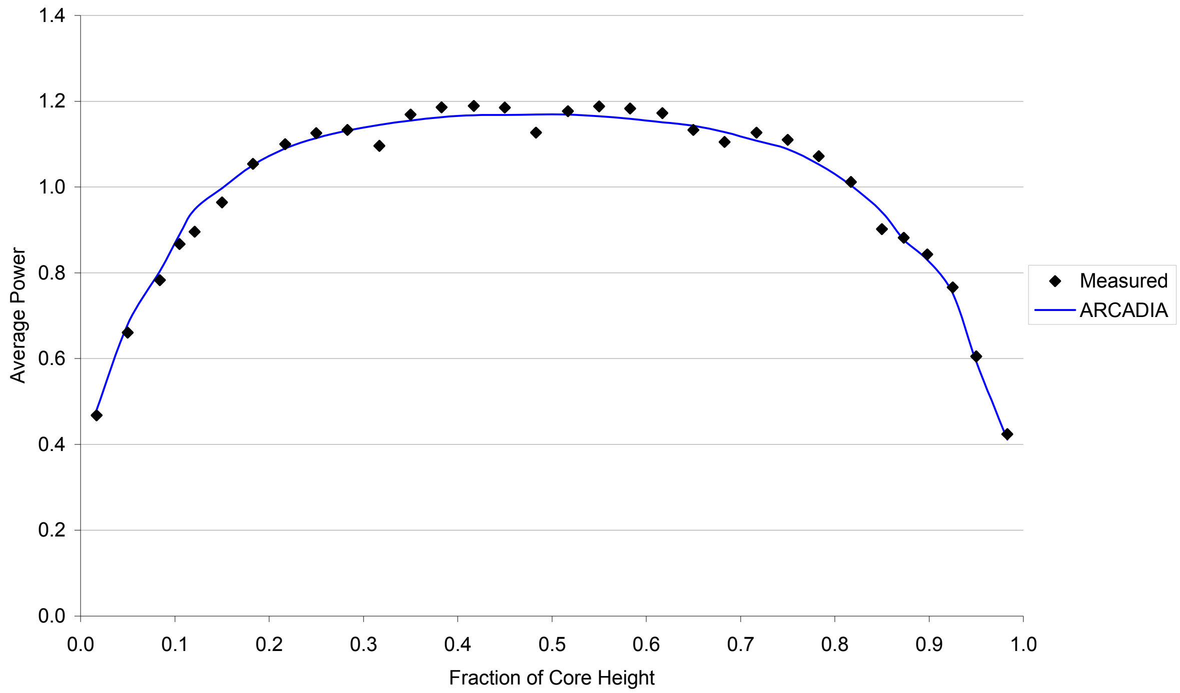
Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G1 10.4.4-20: Plant G1 EOC 30 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P						0.287 0.286 0.1	0.491 0.489 0.2	0.477 0.474 0.2	0.491 0.490 0.1	0.287 0.287 0.0					
O				0.343 0.341 0.2	0.520 0.517 0.3	0.931 0.925 0.5	1.305 1.297 0.7	1.365 1.357 0.8	1.304 1.296 0.7	0.930 0.927 0.3	0.520 0.519 0.1	0.343 0.342 0.1	Calculated Power Measured Power Difference (C-M)*100		
N			0.426 0.425 0.1	1.145 1.138 0.7	1.365 1.356 0.9	1.167 1.160 0.7	1.029 1.023 0.6	1.061 1.056 0.5	1.027 1.022 0.5	1.166 1.162 0.5	1.365 1.359 0.6	1.146 1.142 0.4	0.426 0.425 0.1		
M		0.343 0.342 0.1	1.146 1.144 0.2	0.996 0.989 0.7	1.220 1.210 1.0	1.247 1.239 0.8	1.060 1.054 0.5	1.476 1.470 0.7	1.059 1.056 0.3	1.247 1.242 0.5	1.220 1.215 0.5	0.996 0.993 0.2	1.145 1.142 0.3	0.343 0.343 0.0	
L		0.520 0.517 0.3	1.365 1.355 1.0	1.220 1.201 1.9	1.121 1.108 1.3	1.192 1.184 0.8	1.479 1.472 0.7	1.096 1.093 0.3	1.480 1.476 0.3	1.193 1.191 0.2	1.120 1.118 0.2	1.220 1.218 0.2	1.365 1.362 0.3	0.520 0.521 0.0	
K	0.287 0.285 0.2	0.931 0.923 0.7	1.167 1.156 1.0	1.247 1.232 1.5	1.193 1.182 1.2	0.993 0.989 0.4	1.020 1.019 0.1	1.127 1.126 0.0	1.021 1.021 0.0	0.993 0.994 -0.1	1.192 1.193 -0.1	1.247 1.247 0.0	1.167 1.167 0.0	0.931 0.932 -0.1	0.287 0.288 -0.1
J	0.491 0.487 0.4	1.304 1.293 1.1	1.027 1.019 0.8	1.059 1.052 0.7	1.480 1.472 0.7	1.021 1.023 -0.2	1.323 1.326 -0.3	0.987 0.989 -0.2	1.323 1.327 -0.4	1.020 1.024 -0.4	1.479 1.481 -0.3	1.060 1.062 -0.2	1.029 1.031 -0.2	1.305 1.307 -0.2	0.491 0.491 0.0
H	0.477 0.471 0.6	1.365 1.353 1.2	1.061 1.055 0.6	1.476 1.469 0.7	1.096 1.094 0.2	1.127 1.129 -0.2	0.986 0.990 -0.3	0.821 0.825 -0.4	0.986 0.992 -0.7	1.127 1.135 -0.8	1.096 1.101 -0.5	1.476 1.479 -0.3	1.061 1.063 -0.2	1.365 1.364 0.1	0.477 0.476 0.1
G	0.491 0.487 0.4	1.305 1.296 0.8	1.029 1.025 0.4	1.060 1.058 0.2	1.479 1.477 0.1	1.020 1.022 -0.2	1.323 1.327 -0.4	0.986 0.991 -0.5	1.322 1.333 -1.1	1.021 1.033 -1.2	1.480 1.486 -0.6	1.059 1.062 -0.3	1.027 1.029 -0.3	1.304 1.305 -0.2	0.491 0.492 -0.1
F	0.287 0.286 0.1	0.931 0.927 0.3	1.167 1.165 0.2	1.247 1.246 0.1	1.192 1.193 -0.1	0.993 0.995 -0.2	1.021 1.025 -0.4	1.127 1.131 -0.5	1.020 1.025 -0.5	0.993 0.998 -0.5	1.193 1.196 -0.2	1.247 1.248 -0.1	1.167 1.171 -0.4	0.930 0.934 -0.4	0.287 0.288 -0.1
E		0.520 0.520 0.0	1.365 1.363 0.2	1.220 1.220 -0.1	1.121 1.122 -0.2	1.193 1.197 -0.4	1.480 1.484 -0.5	1.096 1.100 -0.4	1.479 1.481 -0.2	1.192 1.194 -0.2	1.120 1.121 -0.1	1.220 1.220 0.0	1.365 1.375 -1.0	0.520 0.525 -0.4	
D		0.343 0.343 0.0	1.145 1.146 -0.1	0.996 0.998 -0.2	1.220 1.224 -0.3	1.247 1.252 -0.5	1.059 1.065 -0.6	1.476 1.482 -0.6	1.060 1.060 -0.1	1.247 1.249 -0.2	1.220 1.224 -0.5	0.996 1.004 -0.8	1.146 1.163 -1.8	0.343 0.347 -0.4	
C			0.426 0.427 -0.1	1.146 1.149 -0.3	1.365 1.370 -0.5	1.167 1.174 -0.7	1.027 1.035 -0.8	1.061 1.069 -0.8	1.029 1.034 -0.5	1.167 1.172 -0.5	1.365 1.372 -0.7	1.145 1.154 -0.9	0.426 0.431 -0.5		
B				0.343 0.345 -0.2	0.520 0.524 -0.4	0.930 0.939 -0.9	1.304 1.317 -1.4	1.365 1.376 -1.1	1.305 1.313 -0.9	0.931 0.936 -0.6	0.520 0.524 -0.3	0.343 0.346 -0.3			
A						0.287 0.292 -0.5	0.491 0.498 -0.6	0.477 0.481 -0.5	0.491 0.495 -0.4	0.287 0.289 -0.2					

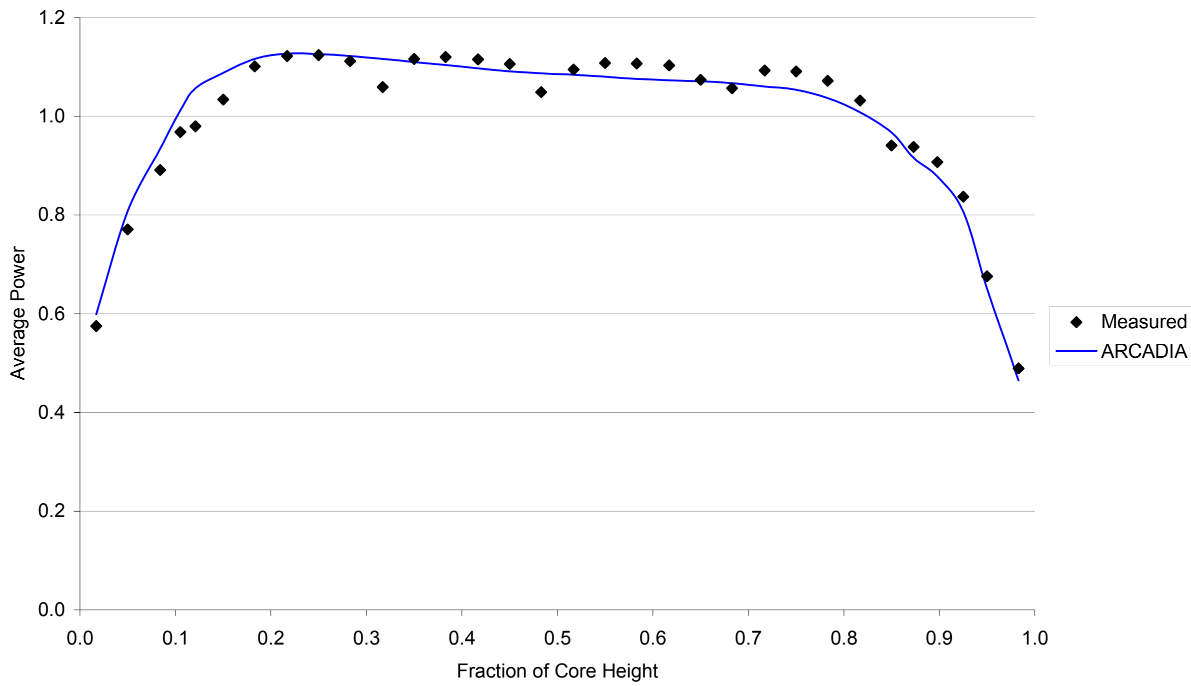
Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure G1 10.4.4-21: Plant G1 BOC 26 Core Average Axial Power Distribution



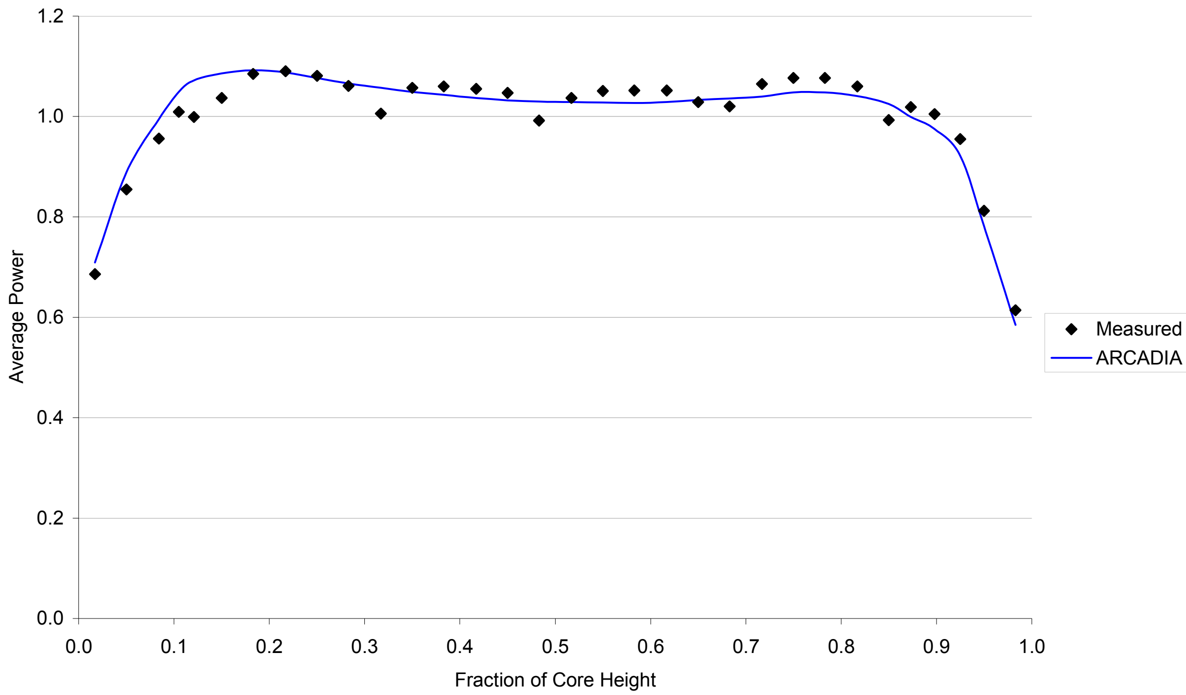
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure G1 10.4.4-22: Plant G1 MOC 26 Core Average Axial Power Distribution



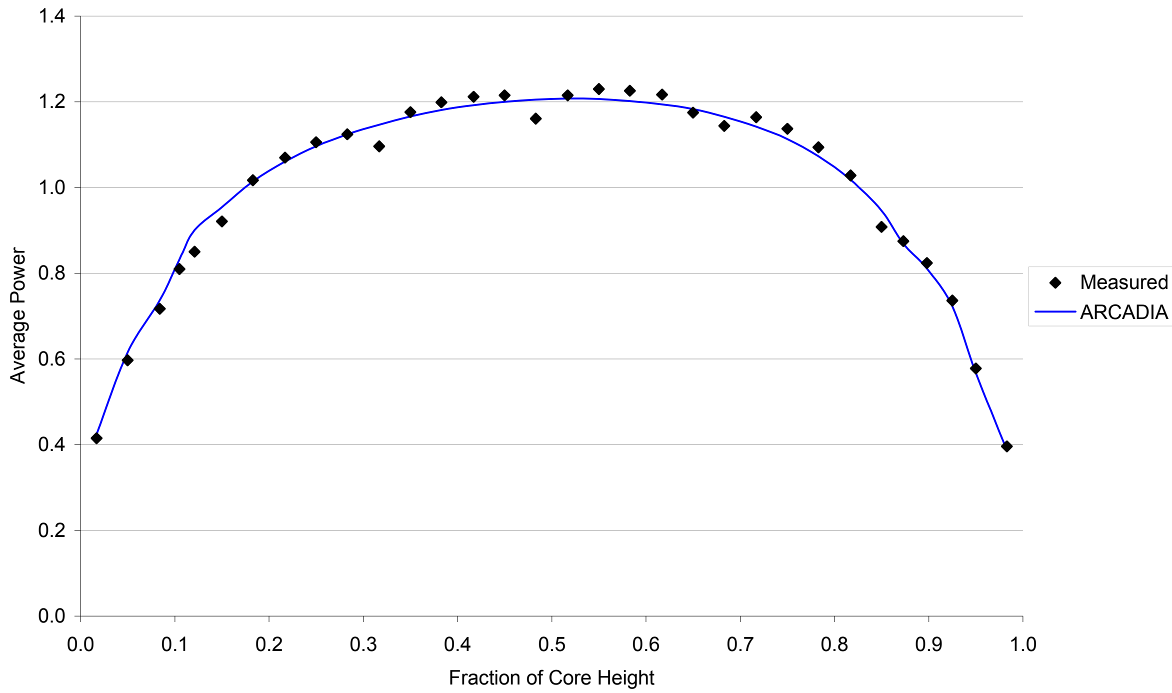
C - M Average Axial Power, RMS Difference *100 = 3.1

Figure G1 10.4.4-23: Plant G1 EOC 26 Core Average Axial Power Distribution



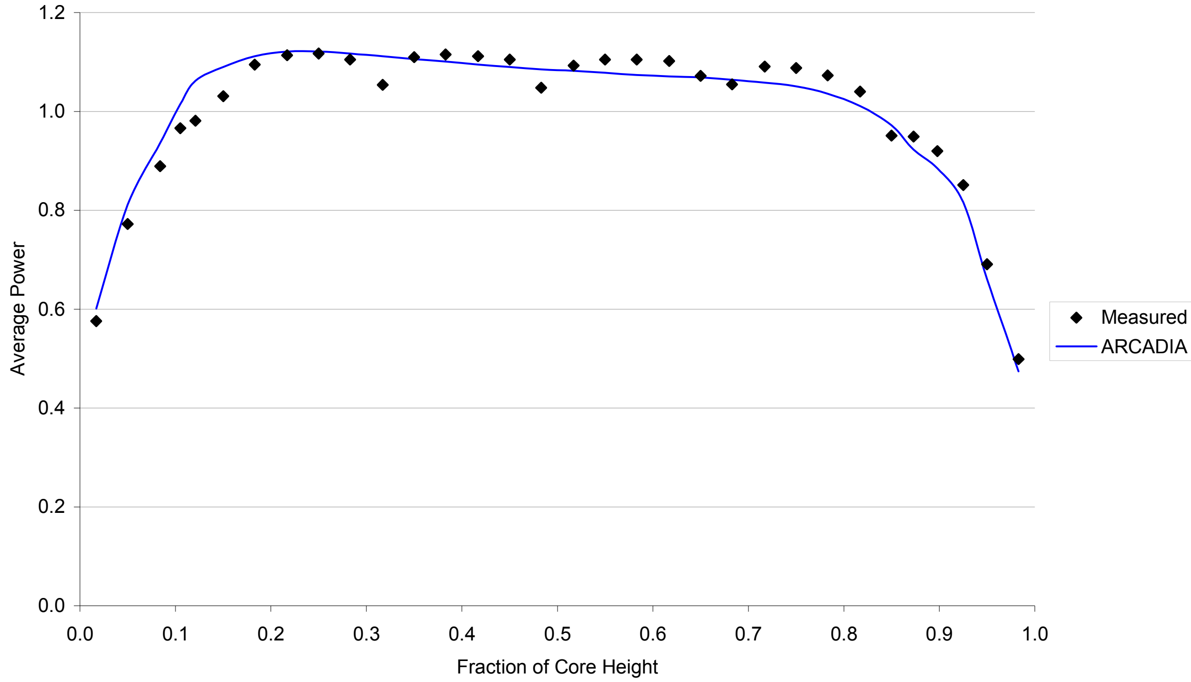
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure G1 10.4.4-24: Plant G1 BOC 27 Core Average Axial Power Distribution



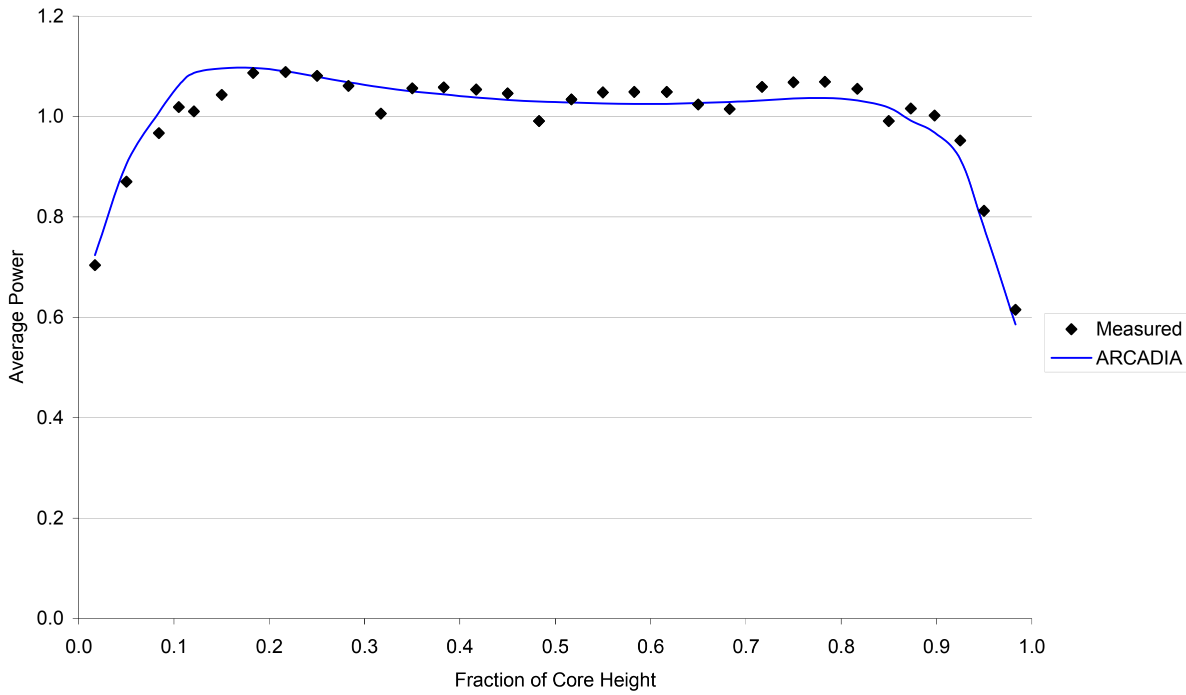
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure G1 10.4.4-25: Plant G1 MOC 27 Core Average Axial Power Distribution



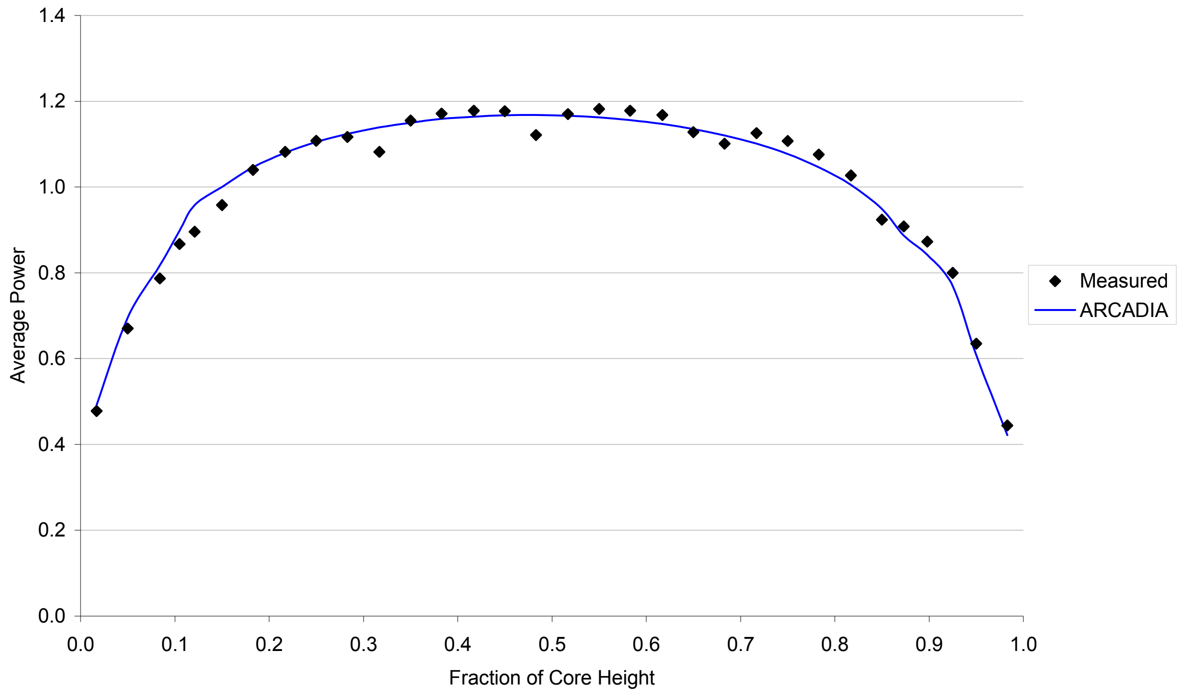
C - M Average Axial Power, RMS Difference *100 = 3.3

Figure G1 10.4.4-26: Plant G1 EOC 27 Core Average Axial Power Distribution



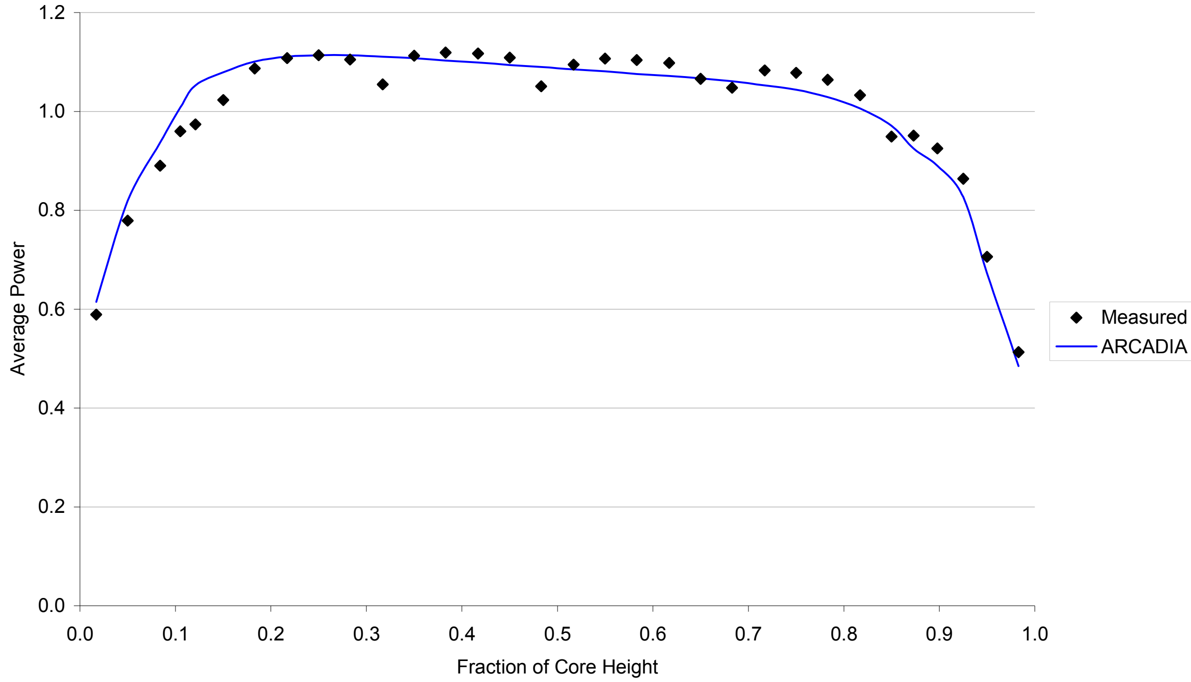
C - M Average Axial Power, RMS Difference *100 = 3.1

Figure G1 10.4.4-27: Plant G1 BOC 28 Core Average Axial Power Distribution



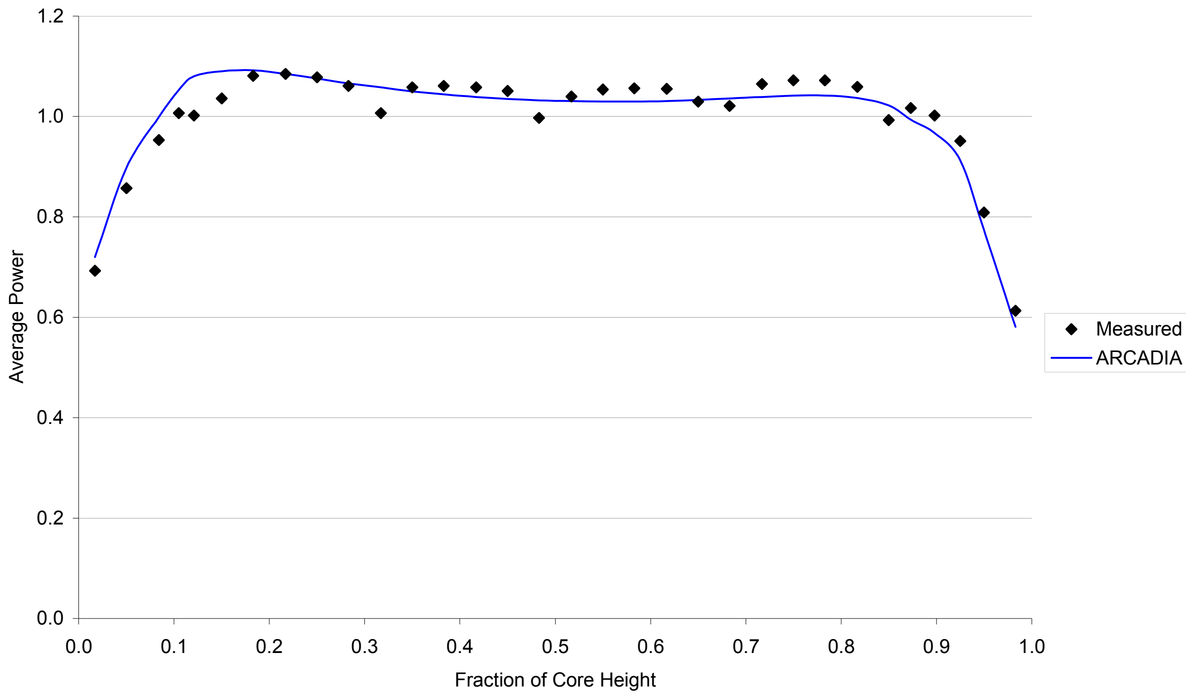
C - M Average Axial Power, RMS Difference *100 = 2.7

Figure G1 10.4.4-28: Plant G1 MOC 28 Core Average Axial Power Distribution



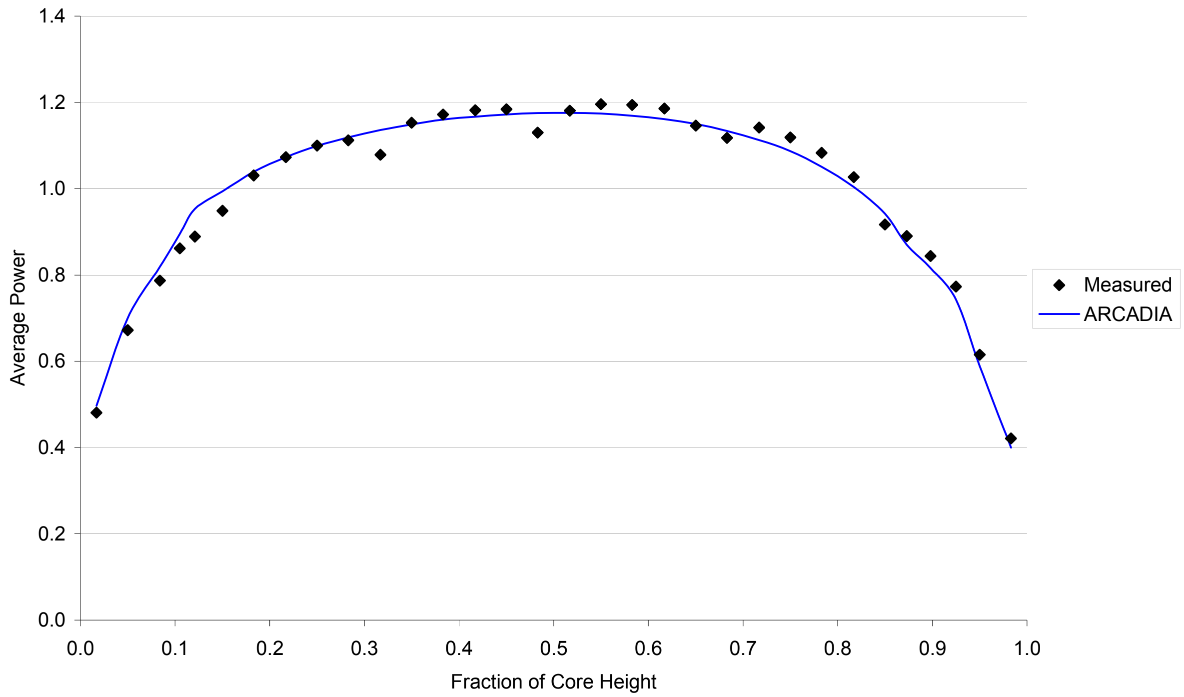
C - M Average Axial Power, RMS Difference *100 = 3.3

Figure G1 10.4.4-29: Plant G1 EOC 28 Core Average Axial Power Distribution



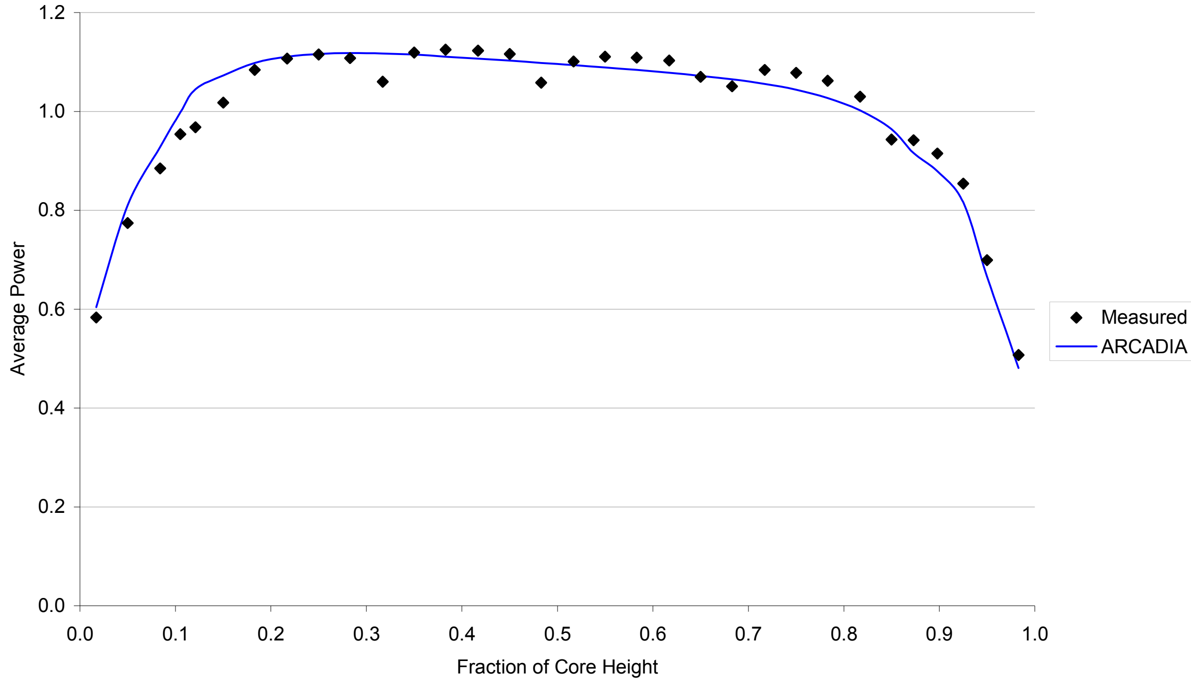
C - M Average Axial Power, RMS Difference *100 = 3.2

Figure G1 10.4.4-30: Plant G1 BOC 29 Core Average Axial Power Distribution



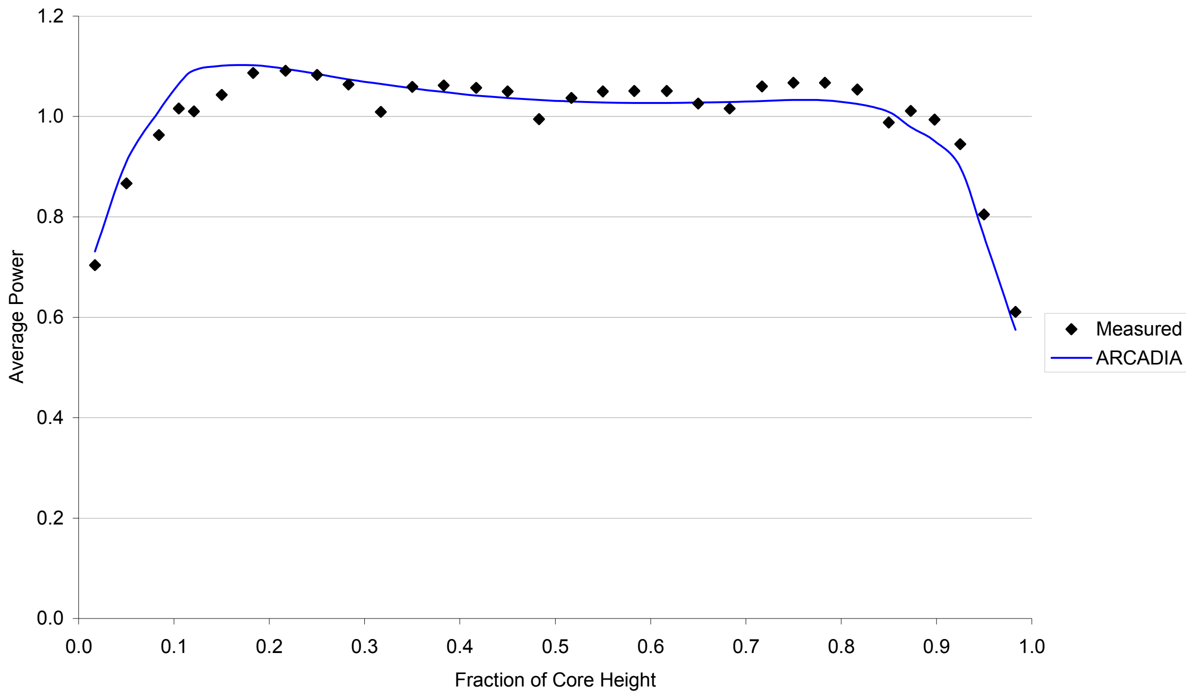
C - M Average Axial Power, RMS Difference *100 = 2.8

Figure G1 10.4.4-31: Plant G1 MOC 29 Core Average Axial Power Distribution



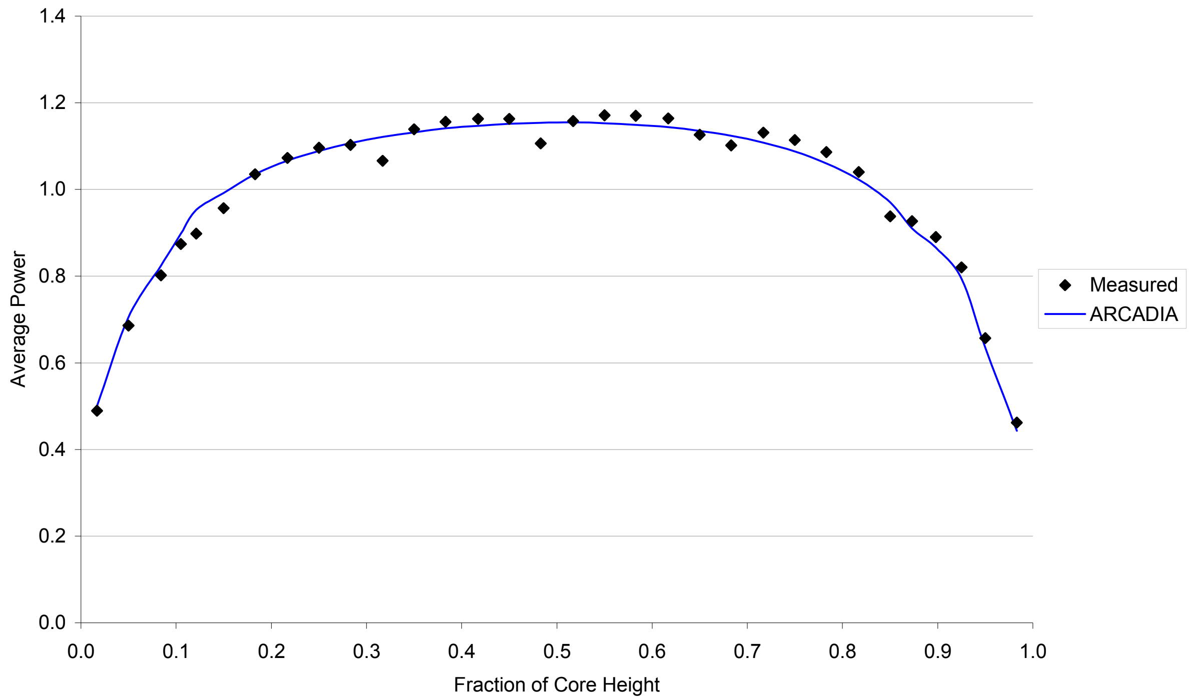
C - M Average Axial Power, RMS Difference *100 = 3.2

Figure G1 10.4.4-32: Plant G1 EOC 29 Core Average Axial Power Distribution



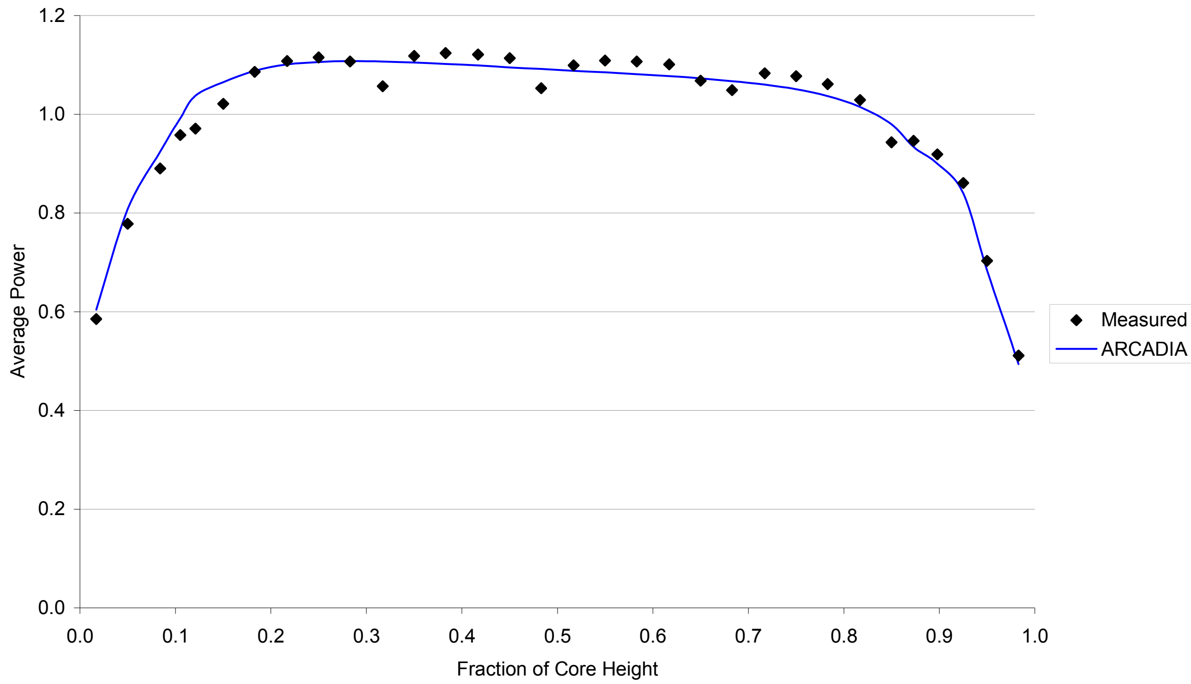
C - M Average Axial Power, RMS Difference *100 = 3.4

Figure G1 10.4.4-33: Plant G1 BOC 30 Core Average Axial Power Distribution



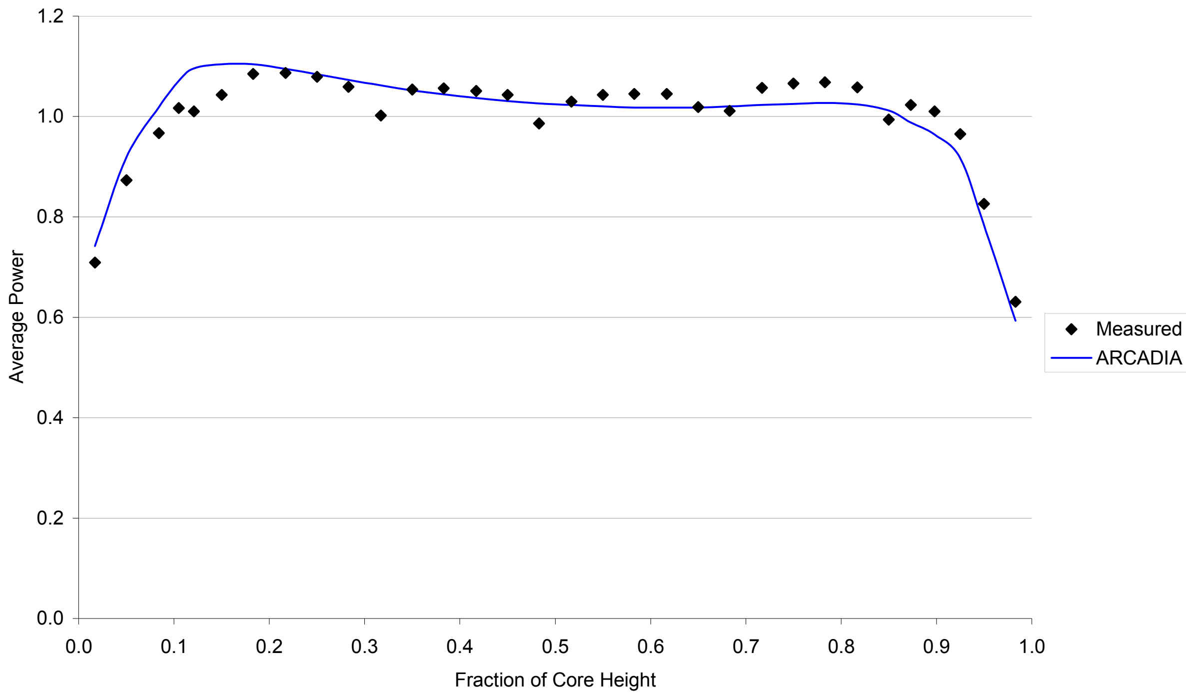
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure G1 10.4.4-34: Plant G1 MOC 30 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 2.7

Figure G1 10.4.4-35: Plant G1 EOC 30 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 3.7

Appendix G2

Table G2 10.3.5-1: Plant G2 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 1-5

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
1	1438	1445	7
2	1419	1383	-36
3	1556	1520	-36
4	1408	1381	-27
5	1541	1499	-42

Data on HZP all rods out isothermal temperature coefficients is not available for Plant G2.

Figure G2 10.2.1-5: Plant G2 Fuel Assembly Guide Tube Configuration

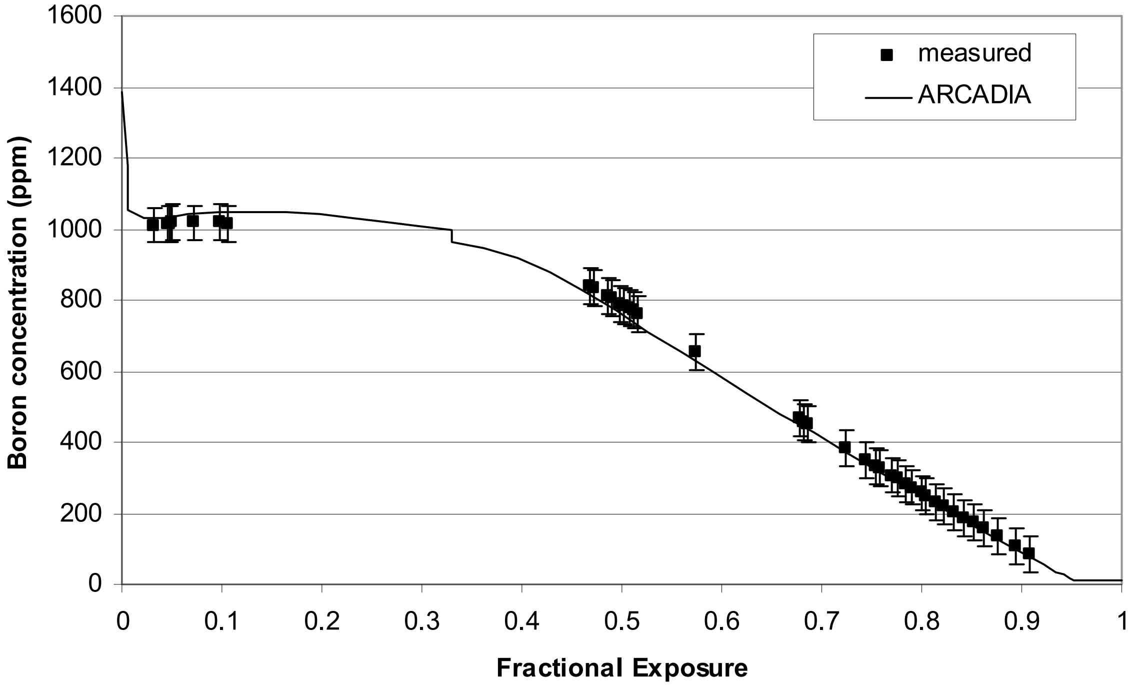
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	1	3	3	3	3	1	3	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	3	3	1	3	3	1	3	3	3	3	3	3	3
3	3	3	3	3	1	3	3	3	3	3	3	1	3	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3
3	3	3	3	1	3	3	3	3	3	3	3	3	1	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	1	3	3	3	3	3	3	3	3	1	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3
3	3	3	3	3	1	3	3	3	3	3	3	1	3	3	3	3	3
3	3	3	3	3	3	3	1	3	3	1	3	3	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	3	1	3	3	3	3	2	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 Guide tube location

2 Guide tube with instrument

3 UO_2 Rod

Figure G2 10.4.5-1: Plant G2 Cycle 1 Critical Boron Concentration vs. Burnup



*The step in the calculated boron concentration at a fractional exposure of 0.33 is the result of a load increase from 80% to 100%.

Figure G2 10.4.5-2: Plant G2 Cycle 2 Critical Boron Concentration vs. Burnup

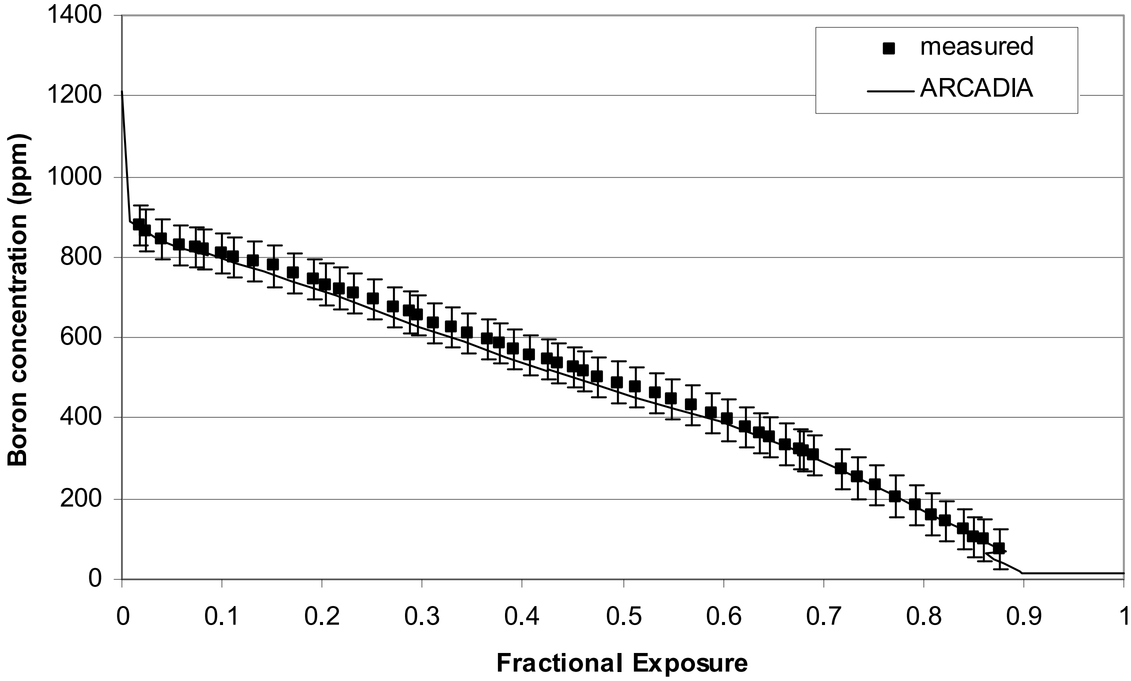


Figure G2 10.4.5-3: Plant G2 Cycle 3 Critical Boron Concentration vs. Burnup

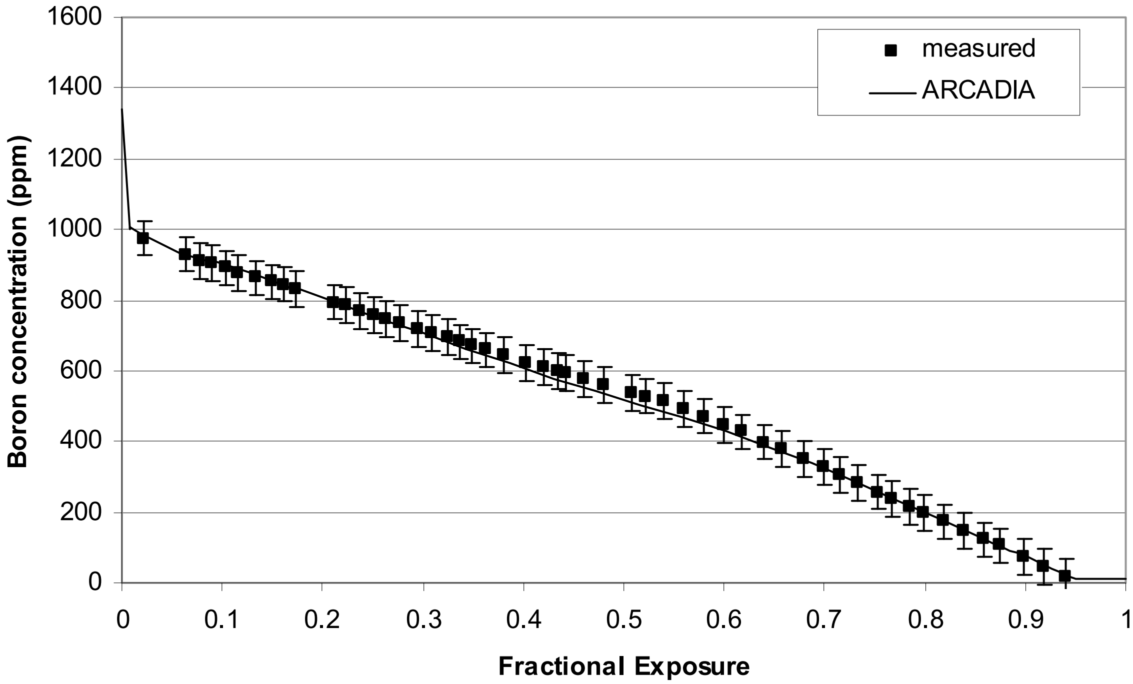
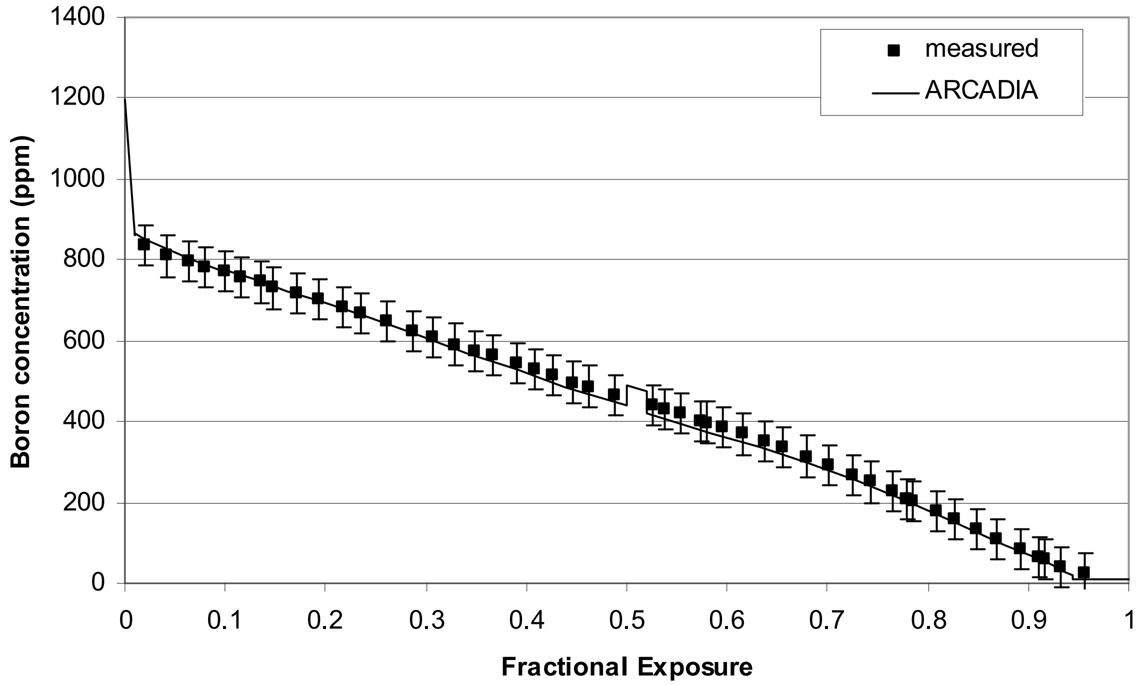


Figure G2 10.4.5-4: Plant G2 Cycle 4 Critical Boron Concentration vs. Burnup



*The sudden rise in the calculated boron concentration is a result of a reduction in power to 93% and the insertion of a control rod bank for the rest of the cycle.

Figure G2 10.4.5-5: Plant G2 Cycle 5 Critical Boron Concentration vs. Burnup

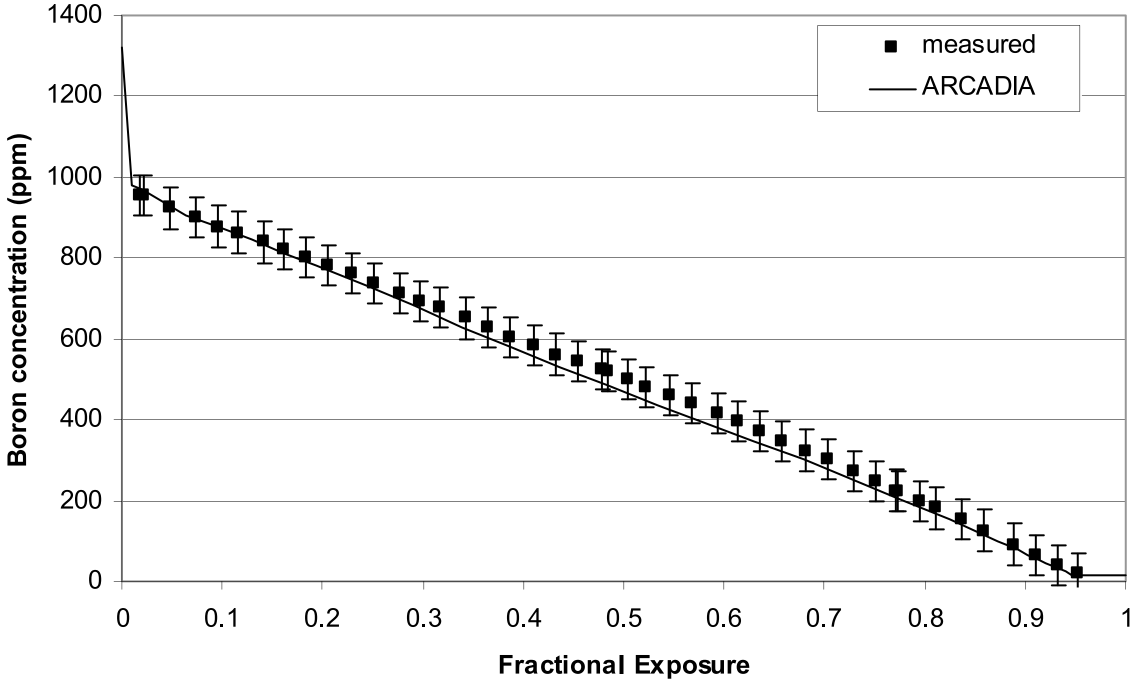


Figure G2 10.4.5-6: Plant G2 BOC 1 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.374 0.378 -0.3	0.524 0.526 -0.3	0.554 0.555 -0.1	0.576 0.577 -0.1	0.558 0.559 -0.1	0.533 0.535 -0.1	0.386 0.387 -0.1				
O			0.353 0.358 -0.4	0.617 0.623 -0.6	1.080 1.091 -1.1	1.208 1.213 -0.5	1.184 1.185 -0.1	1.302 1.306 -0.5	1.195 1.197 -0.2	1.235 1.240 -0.5	1.121 1.125 -0.4	0.636 0.639 -0.3	0.359 0.361 -0.2	Calculated Power Measured Power Difference (C-M)*100	
N		0.357 0.365 -0.8	0.937 0.949 -1.2	1.267 1.276 -0.9	1.003 1.009 -0.7	0.898 0.893 0.6	1.070 1.070 0.0	1.127 1.128 -0.1	1.080 1.082 -0.1	0.925 0.924 0.1	1.066 1.066 0.0	1.298 1.307 -0.9	0.946 0.953 -0.8	0.356 0.358 -0.2	
M		0.632 0.638 -0.5	1.292 1.299 -0.7	1.111 1.112 -0.1	1.079 1.077 0.2	1.235 1.235 0.0	1.061 1.064 -0.3	1.256 1.261 -0.5	1.069 1.070 -0.1	1.254 1.254 0.1	1.106 1.093 1.3	1.117 1.117 0.0	1.275 1.283 -0.8	0.622 0.625 -0.4	
L	0.384 0.387 -0.3	1.113 1.120 -0.6	1.059 1.060 -0.1	1.102 1.093 1.0	1.276 1.271 0.5	1.087 1.084 0.3	1.122 1.120 0.1	1.140 1.141 -0.1	1.127 1.128 0.0	1.090 1.094 -0.4	1.279 1.277 0.2	1.086 1.085 0.2	1.010 1.017 -0.7	1.087 1.093 -0.6	0.377 0.378 -0.2
K	0.532 0.537 -0.5	1.226 1.232 -0.6	0.921 0.916 0.4	1.250 1.243 0.6	1.085 1.079 0.6	1.110 1.108 0.2	1.184 1.182 0.2	1.326 1.328 -0.3	1.187 1.187 0.0	1.114 1.117 -0.3	1.085 1.087 -0.2	1.238 1.243 -0.4	0.901 0.902 -0.2	1.209 1.215 -0.6	0.525 0.526 -0.1
J	0.557 0.557 0.0	1.189 1.186 0.4	1.073 1.064 0.9	1.065 1.056 0.9	1.121 1.114 0.7	1.183 1.180 0.3	1.379 1.379 0.0	1.297 1.297 0.1	1.384 1.385 -0.1	1.187 1.186 0.1	1.123 1.125 -0.2	1.061 1.069 -0.7	1.069 1.070 -0.1	1.183 1.183 0.0	0.555 0.555 0.0
H	0.574 0.572 0.2	1.294 1.288 0.5	1.125 1.107 1.7	1.250 1.241 0.8	1.135 1.130 0.5	1.324 1.324 0.0	1.295 1.294 0.1	1.209 1.210 -0.1	1.300 1.298 0.2	1.327 1.328 0.0	1.140 1.138 0.2	1.253 1.252 0.1	1.124 1.113 1.1	1.301 1.300 0.1	0.577 0.576 0.1
G	0.553 0.550 0.3	1.179 1.173 0.6	1.065 1.059 0.6	1.060 1.059 0.1	1.118 1.116 0.2	1.181 1.180 0.1	1.378 1.379 -0.1	1.295 1.294 0.1	1.381 1.378 0.2	1.187 1.180 0.7	1.123 1.117 0.6	1.069 1.062 0.6	1.080 1.073 0.8	1.195 1.188 0.6	0.560 0.560 0.0
F	0.523 0.521 0.2	1.202 1.199 0.2	0.899 0.894 0.4	1.234 1.231 0.2	1.081 1.080 0.0	1.106 1.110 -0.4	1.182 1.184 -0.1	1.323 1.327 -0.4	1.185 1.182 0.3	1.114 1.109 0.4	1.089 1.083 0.6	1.255 1.250 0.6	0.926 0.921 0.5	1.232 1.236 -0.4	0.535 0.539 -0.4
E	0.375 0.374 0.1	1.081 1.078 0.3	1.006 1.005 0.1	1.084 1.076 0.8	1.275 1.272 0.3	1.089 1.096 -0.7	1.123 1.126 -0.4	1.138 1.144 -0.6	1.121 1.120 0.1	1.085 1.082 0.3	1.278 1.273 0.6	1.106 1.096 1.0	1.065 1.067 -0.1	1.120 1.127 -0.7	0.385 0.389 -0.3
D		0.620 0.617 0.3	1.270 1.263 0.7	1.113 1.101 1.2	1.103 1.085 1.8	1.251 1.249 0.2	1.066 1.067 -0.1	1.254 1.259 -0.5	1.061 1.061 0.0	1.237 1.237 0.0	1.088 1.087 0.2	1.118 1.120 -0.2	1.300 1.311 -1.1	0.637 0.644 -0.7	
C		0.355 0.352 0.3	0.940 0.933 0.7	1.293 1.281 1.2	1.061 1.053 0.8	0.919 0.914 0.5	1.077 1.076 0.0	1.124 1.123 0.1	1.069 1.068 0.1	0.901 0.897 0.4	1.012 1.020 -0.9	1.277 1.290 -1.3	0.944 0.961 -1.6	0.359 0.372 -1.2	
B			0.358 0.355 0.3	0.635 0.630 0.5	1.113 1.107 0.5	1.229 1.227 0.1	1.191 1.190 0.1	1.300 1.302 -0.3	1.181 1.181 0.0	1.211 1.218 -0.7	1.089 1.103 -1.4	0.623 0.631 -0.8	0.355 0.362 -0.6		
A					0.383 0.381 0.2	0.532 0.530 0.1	0.558 0.558 0.1	0.576 0.576 0.0	0.555 0.556 -0.1	0.525 0.528 -0.3	0.376 0.380 -0.4				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure G2 10.4.5-7: Plant G2 MOC 1 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.323 0.329 -0.6	0.453 0.458 -0.6	0.492 0.495 -0.4	0.504 0.506 -0.2	0.494 0.496 -0.2	0.455 0.457 -0.1	0.326 0.327 -0.1				
O			0.328 0.334 -0.5	0.547 0.554 -0.7	0.927 0.942 -1.5	1.054 1.062 -0.8	1.109 1.114 -0.5	1.142 1.146 -0.4	1.118 1.121 -0.3	1.064 1.065 -0.1	0.935 0.937 -0.2	0.550 0.553 -0.3	0.328 0.331 -0.3	Calculated Power Measured Power Difference (C-M)*100	
N		0.329 0.338 -0.9	0.873 0.884 -1.1	1.134 1.143 -0.8	1.089 1.095 -0.6	1.019 1.021 -0.2	1.139 1.143 -0.4	1.199 1.203 -0.5	1.167 1.169 -0.2	1.030 1.031 -0.1	1.096 1.095 0.1	1.136 1.145 -0.9	0.875 0.881 -0.6	0.328 0.330 -0.2	
M		0.550 0.557 -0.7	1.138 1.146 -0.7	1.184 1.185 -0.1	1.234 1.235 0.0	1.338 1.339 -0.2	1.110 1.119 -0.9	1.368 1.371 -0.3	1.117 1.118 -0.1	1.344 1.342 0.2	1.239 1.225 1.5	1.182 1.179 0.3	1.135 1.138 -0.3	0.548 0.550 -0.2	
L	0.326 0.332 -0.5	0.935 0.944 -0.9	1.096 1.099 -0.3	1.242 1.236 0.6	1.397 1.391 0.6	1.138 1.136 0.2	1.244 1.244 0.1	1.272 1.267 0.4	1.247 1.247 0.0	1.134 1.143 -0.8	1.393 1.389 0.4	1.235 1.233 0.3	1.091 1.091 0.0	0.928 0.929 -0.1	0.324 0.324 0.0
K	0.457 0.466 -0.8	1.063 1.073 -1.1	1.032 1.035 -0.3	1.346 1.342 0.5	1.134 1.129 0.5	1.235 1.227 0.7	1.264 1.258 0.5	1.281 1.277 0.4	1.264 1.264 0.0	1.235 1.239 -0.5	1.132 1.135 -0.3	1.336 1.337 -0.1	1.018 1.019 0.0	1.052 1.052 0.1	0.452 0.452 0.0
J	0.496 0.500 -0.4	1.120 1.129 -0.9	1.166 1.163 0.3	1.119 1.114 0.5	1.246 1.240 0.6	1.264 1.253 1.1	1.278 1.271 0.8	1.254 1.250 0.4	1.281 1.278 0.2	1.263 1.264 -0.1	1.243 1.247 -0.4	1.107 1.114 -0.7	1.136 1.133 0.3	1.105 1.104 0.1	0.492 0.492 0.0
H	0.505 0.506 -0.1	1.140 1.138 0.2	1.202 1.190 1.2	1.368 1.361 0.7	1.271 1.268 0.3	1.283 1.278 0.5	1.254 1.249 0.5	1.114 1.110 0.4	1.255 1.250 0.5	1.282 1.277 0.5	1.271 1.269 0.1	1.364 1.361 0.3	1.195 1.186 0.9	1.141 1.139 0.2	0.504 0.505 0.0
G	0.493 0.492 0.1	1.109 1.105 0.4	1.137 1.131 0.6	1.113 1.114 -0.1	1.244 1.245 -0.1	1.263 1.262 0.0	1.278 1.277 0.2	1.252 1.248 0.4	1.278 1.269 0.9	1.264 1.250 1.4	1.243 1.237 0.6	1.117 1.112 0.5	1.166 1.162 0.4	1.118 1.122 -0.3	0.495 0.497 -0.2
F	0.453 0.451 0.2	1.051 1.046 0.5	1.021 1.017 0.4	1.338 1.335 0.3	1.133 1.135 -0.2	1.231 1.236 -0.5	1.263 1.265 -0.2	1.280 1.279 0.2	1.263 1.257 0.6	1.235 1.225 0.9	1.133 1.127 0.7	1.345 1.337 0.7	1.030 1.030 0.0	1.061 1.065 -0.4	0.456 0.461 -0.4
E	0.324 0.323 0.1	0.928 0.923 0.5	1.093 1.086 0.6	1.239 1.233 0.6	1.396 1.394 0.2	1.138 1.147 -0.9	1.246 1.251 -0.5	1.271 1.275 -0.4	1.243 1.242 0.1	1.132 1.129 0.4	1.393 1.383 1.0	1.239 1.229 1.0	1.096 1.095 0.1	0.934 0.938 -0.4	0.325 0.328 -0.3
D		0.550 0.546 0.4	1.136 1.126 1.0	1.184 1.173 1.1	1.241 1.231 1.0	1.346 1.345 0.1	1.118 1.120 -0.3	1.369 1.372 -0.3	1.109 1.111 -0.2	1.336 1.335 0.1	1.238 1.236 0.2	1.184 1.181 0.3	1.138 1.142 -0.4	0.550 0.555 -0.5	
C		0.329 0.326 0.3	0.874 0.865 0.9	1.138 1.125 1.3	1.097 1.090 0.7	1.028 1.026 0.2	1.167 1.167 -0.1	1.197 1.200 -0.2	1.137 1.138 -0.1	1.019 1.023 -0.3	1.093 1.097 -0.4	1.136 1.142 -0.6	0.873 0.883 -0.9	0.329 0.338 -0.9	
B			0.330 0.326 0.3	0.552 0.548 0.4	0.932 0.928 0.5	1.063 1.061 0.2	1.119 1.119 0.0	1.142 1.144 -0.2	1.105 1.110 -0.4	1.054 1.062 -0.8	0.930 0.943 -1.3	0.549 0.555 -0.6	0.328 0.333 -0.5		
A					0.325 0.324 0.1	0.456 0.455 0.1	0.496 0.496 0.0	0.504 0.506 -0.2	0.492 0.495 -0.3	0.452 0.457 -0.5	0.323 0.328 -0.5				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure G2 10.4.5-8: Plant G2 EOC 1 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.471 0.468 0.3	0.613 0.612 0.1	0.641 0.642 -0.1	0.645 0.646 -0.1	0.638 0.639 -0.1	0.608 0.608 0.0	0.467 0.467 0.1				
O			0.470 0.466 0.4	0.695 0.691 0.4	1.048 1.041 0.7	1.137 1.137 0.0	1.161 1.165 -0.4	1.166 1.170 -0.3	1.156 1.157 -0.1	1.129 1.127 0.1	1.037 1.034 0.3	0.690 0.688 0.2	0.467 0.466 0.1		
N		0.468 0.462 0.6	0.986 0.978 0.8	1.172 1.166 0.6	1.118 1.115 0.2	1.052 1.057 -0.5	1.140 1.148 -0.8	1.157 1.163 -0.6	1.136 1.137 -0.2	1.042 1.040 0.2	1.093 1.087 0.6	1.163 1.160 0.3	0.989 0.987 0.2	0.470 0.469 0.1	
M		0.690 0.686 0.4	1.164 1.158 0.6	1.145 1.140 0.5	1.160 1.159 0.1	1.227 1.231 -0.4	1.057 1.067 -1.0	1.232 1.238 -0.7	1.055 1.057 -0.2	1.220 1.217 0.3	1.155 1.140 1.6	1.145 1.136 0.9	1.173 1.170 0.3	0.697 0.696 0.1	
L	0.468 0.467 0.1	1.035 1.033 0.2	1.092 1.089 0.3	1.156 1.152 0.5	1.237 1.235 0.1	1.053 1.055 -0.2	1.130 1.135 -0.5	1.140 1.144 -0.3	1.130 1.133 -0.3	1.047 1.052 -0.4	1.234 1.229 0.5	1.162 1.158 0.5	1.120 1.118 0.2	1.050 1.050 0.1	0.472 0.472 0.0
K	0.609 0.609 0.0	1.126 1.128 -0.2	1.043 1.044 -0.1	1.221 1.220 0.1	1.046 1.046 -0.1	1.113 1.115 -0.2	1.125 1.128 -0.3	1.122 1.125 -0.3	1.125 1.128 -0.3	1.114 1.118 -0.4	1.049 1.052 -0.3	1.227 1.229 -0.2	1.052 1.054 -0.1	1.136 1.137 -0.1	0.613 0.614 -0.1
J	0.639 0.642 -0.2	1.156 1.164 -0.8	1.133 1.135 -0.1	1.056 1.056 -0.1	1.128 1.130 -0.2	1.124 1.126 -0.2	1.121 1.123 -0.2	1.104 1.106 -0.2	1.123 1.125 -0.2	1.125 1.128 -0.3	1.130 1.136 -0.6	1.057 1.066 -1.0	1.138 1.142 -0.4	1.159 1.162 -0.2	0.642 0.643 -0.1
H	0.646 0.647 -0.2	1.164 1.165 -0.2	1.160 1.156 0.4	1.230 1.233 -0.3	1.139 1.145 -0.6	1.124 1.128 -0.4	1.103 1.107 -0.3	1.006 1.007 -0.1	1.106 1.105 0.0	1.123 1.123 0.1	1.141 1.144 -0.3	1.229 1.235 -0.6	1.155 1.158 -0.3	1.167 1.169 -0.2	0.646 0.647 -0.1
G	0.642 0.643 -0.1	1.161 1.162 -0.1	1.138 1.140 -0.2	1.060 1.070 -1.0	1.129 1.139 -0.9	1.124 1.131 -0.7	1.121 1.126 -0.5	1.102 1.104 -0.1	1.121 1.117 0.4	1.125 1.115 1.0	1.126 1.124 0.2	1.055 1.056 -0.1	1.136 1.138 -0.2	1.156 1.160 -0.4	0.640 0.640 0.0
F	0.613 0.613 0.0	1.133 1.133 0.0	1.054 1.055 -0.1	1.227 1.231 -0.4	1.048 1.055 -0.7	1.110 1.120 -1.0	1.123 1.130 -0.7	1.122 1.125 -0.3	1.125 1.123 0.2	1.114 1.109 0.6	1.047 1.044 0.3	1.222 1.219 0.2	1.043 1.042 0.1	1.126 1.123 0.3	0.609 0.605 0.5
E	0.472 0.472 0.1	1.049 1.046 0.2	1.121 1.118 0.3	1.164 1.162 0.2	1.235 1.239 -0.4	1.050 1.062 -1.2	1.128 1.136 -0.8	1.141 1.147 -0.7	1.129 1.131 -0.2	1.049 1.048 0.1	1.234 1.230 0.4	1.155 1.150 0.5	1.093 1.088 0.4	1.036 1.031 0.5	0.467 0.464 0.3
D		0.698 0.694 0.4	1.173 1.165 0.8	1.145 1.136 0.9	1.156 1.148 0.7	1.221 1.224 -0.2	1.055 1.059 -0.5	1.232 1.238 -0.6	1.057 1.061 -0.4	1.226 1.226 0.0	1.164 1.162 0.2	1.146 1.141 0.4	1.165 1.160 0.5	0.690 0.687 0.3	
C		0.471 0.467 0.3	0.987 0.977 1.0	1.163 1.150 1.3	1.093 1.087 0.6	1.039 1.038 0.1	1.135 1.138 -0.2	1.156 1.159 -0.4	1.139 1.142 -0.3	1.053 1.054 -0.1	1.122 1.120 0.2	1.174 1.170 0.4	0.987 0.982 0.5	0.468 0.465 0.3	
B			0.468 0.464 0.4	0.692 0.686 0.5	1.034 1.029 0.5	1.127 1.126 0.2	1.156 1.156 -0.1	1.166 1.168 -0.2	1.158 1.160 -0.2	1.137 1.138 0.0	1.051 1.050 0.2	0.697 0.696 0.2	0.469 0.467 0.2		
A					0.466 0.465 0.2	0.609 0.608 0.1	0.640 0.640 0.0	0.646 0.647 -0.1	0.642 0.643 -0.1	0.613 0.613 0.0	0.471 0.471 0.0				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.4

Figure G2 10.4.5-9: Plant G2 BOC 2 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.395 0.391 0.4	0.526 0.521 0.5	0.528 0.525 0.4	0.520 0.517 0.3	0.526 0.522 0.3	0.519 0.515 0.4	0.388 0.385 0.3				
O			0.383 0.384 -0.2	0.684 0.682 0.2	1.315 1.304 1.1	1.260 1.249 1.1	1.369 1.361 0.8	1.241 1.236 0.6	1.360 1.353 0.7	1.241 1.233 0.8	1.287 1.276 1.1	0.674 0.665 0.8	0.380 0.374 0.5	Calculated Power Measured Power Difference (C-M)*100	
N		0.380 0.385 -0.5	1.145 1.153 -0.8	1.355 1.357 -0.2	1.377 1.373 0.4	0.961 0.954 0.7	0.923 0.918 0.4	0.993 0.989 0.4	0.919 0.915 0.4	0.942 0.935 0.7	1.326 1.315 1.1	1.336 1.315 2.1	1.146 1.131 1.5	0.383 0.378 0.5	
M		0.673 0.677 -0.5	1.336 1.343 -0.8	1.103 1.106 -0.3	1.014 1.013 0.0	0.999 0.998 0.1	1.259 1.260 0.0	1.078 1.078 0.0	1.250 1.247 0.3	0.986 0.980 0.6	0.999 0.989 1.0	1.106 1.092 1.4	1.356 1.341 1.5	0.686 0.679 0.6	
L	0.389 0.391 -0.2	1.287 1.294 -0.7	1.326 1.334 -0.8	0.999 1.002 -0.3	1.181 1.185 -0.5	0.927 0.930 -0.3	1.110 1.113 -0.4	1.337 1.342 -0.5	1.110 1.109 0.1	0.922 0.915 0.7	1.181 1.172 0.9	1.015 1.006 0.9	1.378 1.369 0.9	1.316 1.309 0.7	0.396 0.393 0.2
K	0.520 0.522 -0.2	1.241 1.245 -0.3	0.939 0.940 -0.1	0.988 0.990 -0.3	0.922 0.927 -0.4	1.244 1.256 -1.2	1.075 1.083 -0.8	1.065 1.069 -0.4	1.075 1.074 0.0	1.245 1.241 0.4	0.927 0.922 0.4	1.001 0.997 0.4	0.960 0.956 0.4	1.261 1.257 0.4	0.528 0.526 0.2
J	0.525 0.524 0.0	1.360 1.357 0.3	0.920 0.918 0.2	1.250 1.251 -0.1	1.107 1.113 -0.6	1.075 1.090 -1.5	1.309 1.322 -1.3	1.110 1.115 -0.4	1.310 1.311 -0.1	1.077 1.076 0.2	1.114 1.113 0.1	1.260 1.262 -0.2	0.926 0.926 0.1	1.370 1.369 0.1	0.529 0.528 0.1
H	0.520 0.519 0.1	1.242 1.240 0.2	0.992 0.987 0.5	1.081 1.080 0.1	1.337 1.342 -0.5	1.061 1.069 -0.8	1.111 1.118 -0.7	0.855 0.858 -0.3	1.110 1.109 0.0	1.066 1.064 0.2	1.337 1.337 0.0	1.079 1.081 -0.2	0.991 0.992 -0.1	1.242 1.243 -0.2	0.520 0.520 0.0
G	0.528 0.527 0.1	1.370 1.368 0.2	0.928 0.926 0.2	1.260 1.259 0.1	1.111 1.114 -0.3	1.076 1.082 -0.6	1.310 1.317 -0.8	1.114 1.117 -0.3	1.310 1.308 0.2	1.075 1.068 0.7	1.110 1.108 0.2	1.251 1.252 -0.1	0.919 0.920 -0.1	1.360 1.362 -0.2	0.524 0.525 -0.1
F	0.527 0.526 0.1	1.260 1.259 0.1	0.959 0.957 0.2	1.000 1.001 -0.1	0.926 0.930 -0.4	1.244 1.254 -1.0	1.075 1.082 -0.7	1.065 1.071 -0.6	1.079 1.079 -0.1	1.245 1.243 0.2	0.922 0.921 0.1	0.990 0.991 -0.1	0.943 0.944 -0.2	1.242 1.246 -0.4	0.521 0.521 -0.1
E	0.395 0.395 0.1	1.316 1.314 0.2	1.378 1.376 0.1	1.014 1.014 0.0	1.181 1.189 -0.8	0.922 0.931 -0.9	1.106 1.116 -1.0	1.337 1.351 -1.4	1.115 1.121 -0.6	0.923 0.924 -0.1	1.181 1.183 -0.3	1.000 1.004 -0.3	1.326 1.334 -0.8	1.288 1.294 -0.7	0.389 0.390 -0.1
D		0.685 0.683 0.3	1.355 1.350 0.6	1.104 1.101 0.3	0.999 1.004 -0.5	0.986 0.992 -0.6	1.250 1.260 -1.0	1.079 1.090 -1.1	1.259 1.272 -1.2	0.995 0.998 -0.3	1.013 1.014 -0.1	1.106 1.110 -0.3	1.336 1.343 -0.7	0.673 0.677 -0.4	
C		0.383 0.380 0.2	1.145 1.137 0.8	1.335 1.325 1.1	1.325 1.328 -0.3	0.941 0.944 -0.3	0.919 0.924 -0.5	0.994 0.999 -0.5	0.928 0.932 -0.4	0.959 0.957 0.2	1.377 1.375 0.2	1.356 1.357 -0.2	1.146 1.153 -0.8	0.380 0.384 -0.5	
B			0.378 0.376 0.3	0.671 0.669 0.3	1.286 1.288 -0.1	1.241 1.245 -0.4	1.360 1.365 -0.6	1.241 1.246 -0.5	1.369 1.370 -0.1	1.260 1.254 0.6	1.315 1.303 1.2	0.684 0.683 0.2	0.382 0.383 -0.1		
A					0.387 0.388 0.0	0.520 0.521 -0.1	0.524 0.526 -0.1	0.519 0.520 -0.1	0.526 0.526 0.1	0.525 0.522 0.3	0.395 0.391 0.4				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure G2 10.4.5-10: Plant G2 MOC 2 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.398 0.390 0.8	0.527 0.519 0.8	0.520 0.515 0.5	0.519 0.516 0.3	0.523 0.521 0.2	0.533 0.530 0.3	0.404 0.401 0.3				
O			0.402 0.399 0.2	0.689 0.681 0.7	1.230 1.206 2.4	1.244 1.227 1.7	1.256 1.248 0.9	1.216 1.211 0.5	1.263 1.258 0.5	1.259 1.252 0.7	1.252 1.242 1.0	0.700 0.693 0.7	0.404 0.399 0.4	Calculated Power Measured Power Difference (C-M)*100	
N		0.404 0.403 0.1	1.130 1.126 0.4	1.393 1.384 0.9	1.381 1.369 1.1	0.938 0.932 0.6	0.894 0.892 0.2	0.958 0.958 0.1	0.901 0.900 0.2	0.952 0.948 0.4	1.422 1.411 1.1	1.406 1.388 1.8	1.131 1.118 1.3	0.401 0.398 0.4	
M		0.699 0.697 0.2	1.406 1.403 0.3	1.112 1.110 0.2	1.011 1.010 0.1	0.989 0.989 0.0	1.286 1.291 -0.6	1.067 1.072 -0.6	1.287 1.289 -0.2	0.995 0.992 0.3	1.022 1.015 0.7	1.114 1.104 1.0	1.393 1.381 1.2	0.691 0.686 0.5	
L	0.405 0.403 0.2	1.252 1.248 0.4	1.422 1.420 0.2	1.022 1.024 -0.2	1.244 1.249 -0.4	0.937 0.942 -0.5	1.093 1.100 -0.7	1.368 1.381 -1.3	1.098 1.102 -0.5	0.937 0.935 0.3	1.245 1.239 0.6	1.012 1.008 0.5	1.381 1.375 0.6	1.230 1.226 0.4	0.398 0.397 0.1
K	0.535 0.530 0.4	1.259 1.254 0.6	0.950 0.948 0.2	0.996 0.998 -0.1	0.938 0.942 -0.5	1.297 1.308 -1.1	1.058 1.067 -0.9	1.042 1.050 -0.8	1.059 1.064 -0.4	1.298 1.299 -0.1	0.937 0.936 0.0	0.990 0.990 0.0	0.937 0.936 0.1	1.245 1.244 0.1	0.529 0.529 0.0
J	0.522 0.520 0.3	1.263 1.257 0.6	0.902 0.899 0.3	1.287 1.288 -0.1	1.095 1.100 -0.6	1.060 1.072 -1.2	1.331 1.344 -1.3	1.079 1.087 -0.8	1.331 1.337 -0.6	1.061 1.064 -0.3	1.096 1.100 -0.4	1.286 1.293 -0.7	0.897 0.899 -0.3	1.257 1.259 -0.2	0.520 0.521 -0.1
H	0.519 0.517 0.2	1.217 1.211 0.6	0.957 0.952 0.5	1.069 1.070 -0.1	1.368 1.375 -0.7	1.038 1.047 -0.9	1.080 1.089 -0.9	0.853 0.859 -0.6	1.078 1.083 -0.5	1.042 1.046 -0.3	1.368 1.374 -0.5	1.068 1.074 -0.6	0.956 0.962 -0.6	1.217 1.221 -0.4	0.519 0.521 -0.2
G	0.519 0.517 0.2	1.257 1.252 0.5	0.898 0.896 0.2	1.286 1.290 -0.4	1.093 1.100 -0.7	1.060 1.068 -0.9	1.331 1.343 -1.2	1.083 1.090 -0.8	1.332 1.336 -0.4	1.060 1.059 0.1	1.097 1.100 -0.3	1.287 1.293 -0.6	0.901 0.906 -0.5	1.263 1.269 -0.5	0.522 0.523 -0.2
F	0.529 0.526 0.2	1.245 1.239 0.6	0.936 0.933 0.3	0.990 0.991 -0.1	0.936 0.942 -0.6	1.297 1.310 -1.3	1.060 1.071 -1.1	1.042 1.053 -1.1	1.062 1.068 -0.6	1.298 1.301 -0.3	0.937 0.940 -0.3	0.999 1.002 -0.3	0.953 0.956 -0.3	1.259 1.262 -0.3	0.535 0.535 0.0
E	0.398 0.396 0.2	1.230 1.222 0.8	1.381 1.372 0.9	1.011 1.009 0.2	1.244 1.251 -0.6	0.938 0.949 -1.1	1.093 1.107 -1.5	1.368 1.390 -2.2	1.098 1.108 -1.1	0.933 0.938 -0.5	1.245 1.248 -0.3	1.023 1.026 -0.2	1.422 1.426 -0.4	1.252 1.255 -0.3	0.405 0.405 0.0
D		0.690 0.684 0.7	1.393 1.377 1.5	1.113 1.103 1.0	1.023 1.022 0.1	0.995 1.000 -0.6	1.287 1.300 -1.3	1.067 1.081 -1.4	1.286 1.301 -1.5	0.985 0.990 -0.5	1.011 1.013 -0.2	1.115 1.117 -0.2	1.407 1.411 -0.4	0.699 0.702 -0.3	
C		0.402 0.397 0.5	1.130 1.113 1.8	1.406 1.382 2.4	1.422 1.413 0.8	0.951 0.952 -0.1	0.901 0.906 -0.5	0.959 0.966 -0.7	0.898 0.904 -0.6	0.936 0.938 -0.1	1.381 1.377 0.4	1.393 1.392 0.1	1.130 1.135 -0.5	0.404 0.408 -0.5	
B			0.402 0.397 0.6	0.698 0.690 0.8	1.252 1.245 0.7	1.259 1.257 0.2	1.263 1.266 -0.2	1.216 1.220 -0.3	1.256 1.257 -0.1	1.244 1.237 0.7	1.230 1.215 1.5	0.689 0.687 0.3	0.401 0.402 -0.1		
A					0.404 0.402 0.2	0.535 0.534 0.1	0.522 0.522 -0.1	0.518 0.519 -0.1	0.517 0.517 0.1	0.527 0.523 0.4	0.398 0.393 0.5				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G2 10.4.5-11: Plant G2 EOC 2 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.435 0.427 0.8	0.573 0.566 0.7	0.564 0.561 0.3	0.565 0.563 0.2	0.561 0.559 0.2	0.568 0.566 0.3	0.432 0.430 0.2				
O			0.426 0.425 0.1	0.702 0.697 0.5	1.203 1.182 2.1	1.251 1.239 1.2	1.251 1.246 0.5	1.230 1.226 0.4	1.236 1.231 0.5	1.238 1.232 0.6	1.196 1.188 0.7	0.701 0.696 0.5	0.425 0.423 0.3	Calculated Power Measured Power Difference (C-M)*100	
N		0.425 0.427 -0.2	1.085 1.086 -0.1	1.333 1.330 0.3	1.353 1.348 0.6	0.956 0.956 0.0	0.915 0.915 -0.1	0.967 0.967 0.0	0.885 0.883 0.2	0.942 0.937 0.5	1.346 1.336 1.0	1.329 1.320 1.0	1.085 1.078 0.6	0.426 0.423 0.2	
M		0.700 0.700 0.0	1.330 1.331 -0.1	1.076 1.079 -0.2	1.018 1.020 -0.2	1.007 1.009 -0.2	1.299 1.304 -0.4	1.063 1.067 -0.4	1.285 1.284 0.1	0.998 0.990 0.7	1.014 1.001 1.3	1.079 1.069 1.0	1.333 1.325 0.8	0.703 0.700 0.3	
L	0.433 0.431 0.2	1.196 1.192 0.4	1.346 1.346 0.0	1.015 1.021 -0.6	1.272 1.278 -0.6	0.964 0.967 -0.3	1.093 1.097 -0.4	1.348 1.358 -1.0	1.093 1.093 0.1	0.960 0.947 1.3	1.272 1.257 1.5	1.019 1.011 0.7	1.353 1.348 0.6	1.203 1.199 0.4	0.435 0.435 0.1
K	0.569 0.564 0.5	1.238 1.230 0.8	0.940 0.938 0.2	0.999 1.001 -0.2	0.960 0.963 -0.3	1.311 1.315 -0.4	1.059 1.062 -0.3	1.039 1.041 -0.2	1.059 1.057 0.2	1.311 1.301 1.0	0.963 0.957 0.6	1.009 1.006 0.2	0.955 0.954 0.1	1.250 1.249 0.1	0.575 0.574 0.0
J	0.560 0.556 0.4	1.236 1.226 1.0	0.886 0.883 0.4	1.285 1.285 0.0	1.090 1.093 -0.2	1.060 1.063 -0.3	1.324 1.327 -0.3	1.077 1.078 -0.1	1.324 1.322 0.2	1.061 1.058 0.3	1.096 1.097 -0.1	1.299 1.307 -0.8	0.917 0.920 -0.2	1.251 1.252 -0.1	0.564 0.565 -0.1
H	0.565 0.563 0.2	1.230 1.225 0.5	0.966 0.963 0.2	1.065 1.066 -0.1	1.348 1.351 -0.3	1.035 1.038 -0.3	1.077 1.080 -0.2	0.874 0.874 0.0	1.076 1.073 0.3	1.039 1.036 0.3	1.348 1.349 -0.1	1.063 1.068 -0.5	0.965 0.969 -0.4	1.230 1.232 -0.3	0.565 0.566 -0.1
G	0.564 0.563 0.1	1.251 1.249 0.2	0.919 0.919 0.0	1.299 1.302 -0.2	1.093 1.097 -0.4	1.060 1.064 -0.4	1.324 1.327 -0.3	1.080 1.080 0.0	1.324 1.318 0.6	1.059 1.050 0.9	1.092 1.091 0.1	1.285 1.287 -0.2	0.885 0.887 -0.3	1.236 1.239 -0.3	0.559 0.560 -0.1
F	0.575 0.574 0.0	1.250 1.250 0.1	0.954 0.955 -0.1	1.008 1.011 -0.3	0.962 0.968 -0.5	1.311 1.319 -0.8	1.060 1.064 -0.4	1.039 1.040 -0.1	1.063 1.061 0.2	1.311 1.306 0.5	0.959 0.958 0.0	1.001 1.003 -0.1	0.943 0.945 -0.2	1.238 1.239 -0.1	0.570 0.569 0.1
E	0.435 0.435 0.0	1.203 1.203 0.0	1.353 1.354 -0.1	1.018 1.021 -0.3	1.272 1.280 -0.8	0.960 0.969 -0.9	1.088 1.094 -0.6	1.348 1.352 -0.4	1.098 1.101 -0.3	0.959 0.961 -0.2	1.272 1.274 -0.2	1.016 1.018 -0.2	1.346 1.349 -0.3	1.196 1.197 -0.2	0.433 0.433 0.0
D		0.703 0.703 0.0	1.333 1.332 0.0	1.077 1.078 -0.1	1.015 1.019 -0.4	0.998 1.004 -0.6	1.285 1.292 -0.7	1.063 1.070 -0.7	1.299 1.310 -1.1	1.004 1.010 -0.6	1.018 1.021 -0.3	1.079 1.082 -0.3	1.329 1.334 -0.5	0.700 0.703 -0.3	
C		0.426 0.426 0.0	1.085 1.084 0.1	1.329 1.327 0.2	1.346 1.349 -0.3	0.942 0.946 -0.4	0.886 0.891 -0.5	0.968 0.975 -0.7	0.919 0.929 -0.9	0.955 0.965 -1.0	1.353 1.356 -0.3	1.333 1.336 -0.3	1.085 1.091 -0.6	0.425 0.430 -0.5	
B			0.424 0.424 0.0	0.699 0.700 0.0	1.196 1.199 -0.3	1.238 1.243 -0.5	1.236 1.242 -0.6	1.230 1.238 -0.8	1.251 1.259 -0.8	1.251 1.253 -0.3	1.203 1.194 0.9	0.702 0.702 0.0	0.425 0.427 -0.2		
A					0.432 0.433 -0.1	0.570 0.572 -0.2	0.559 0.562 -0.3	0.564 0.567 -0.3	0.562 0.565 -0.3	0.573 0.572 0.1	0.436 0.432 0.3				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure G2 10.4.5-12: Plant G2 BOC 3 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.278 0.279 -0.1	0.336 0.335 0.0	0.349 0.348 0.1	0.356 0.355 0.1	0.352 0.351 0.1	0.339 0.338 0.1	0.281 0.279 0.1				
O			0.282 0.284 -0.3	0.512 0.515 -0.2	1.082 1.086 -0.5	1.064 1.059 0.5	1.079 1.073 0.6	1.210 1.206 0.3	1.092 1.089 0.3	1.076 1.071 0.4	1.090 1.085 0.6	0.518 0.515 0.4	0.282 0.280 0.2	Calculated Power Measured Power Difference (C-M)*100	
N		0.282 0.289 -0.7	1.037 1.047 -0.9	1.205 1.208 -0.2	1.179 1.176 0.2	1.184 1.170 1.3	1.090 1.085 0.5	1.017 1.017 0.0	1.118 1.117 0.1	1.198 1.195 0.4	1.188 1.181 0.7	1.212 1.201 1.1	1.037 1.030 0.7	0.280 0.279 0.2	
M		0.517 0.520 -0.3	1.212 1.216 -0.4	1.238 1.237 0.1	1.231 1.228 0.3	1.362 1.358 0.4	1.013 1.016 -0.3	1.283 1.289 -0.6	1.016 1.019 -0.3	1.370 1.368 0.2	1.238 1.227 1.2	1.238 1.228 1.0	1.205 1.198 0.7	0.513 0.511 0.2	
L	0.280 0.284 -0.3	1.090 1.095 -0.4	1.188 1.188 0.0	1.239 1.233 0.5	1.237 1.232 0.4	1.267 1.264 0.3	1.404 1.406 -0.2	1.269 1.278 -0.9	1.407 1.414 -0.7	1.269 1.273 -0.4	1.236 1.233 0.2	1.231 1.227 0.3	1.178 1.176 0.2	1.081 1.080 0.1	0.278 0.278 0.0
K	0.339 0.344 -0.5	1.076 1.075 0.1	1.199 1.195 0.4	1.371 1.366 0.5	1.270 1.266 0.4	1.243 1.238 0.5	1.244 1.242 0.2	1.016 1.018 -0.2	1.252 1.256 -0.4	1.242 1.247 -0.5	1.265 1.270 -0.5	1.361 1.365 -0.4	1.183 1.185 -0.2	1.064 1.064 0.0	0.335 0.335 0.0
J	0.352 0.351 0.1	1.092 1.080 1.3	1.118 1.113 0.5	1.019 1.017 0.2	1.408 1.404 0.4	1.254 1.246 0.8	1.276 1.272 0.4	1.382 1.381 0.0	1.272 1.273 -0.1	1.241 1.245 -0.4	1.402 1.412 -1.0	1.011 1.024 -1.3	1.089 1.095 -0.5	1.078 1.079 -0.1	0.349 0.349 0.0
H	0.356 0.355 0.1	1.210 1.206 0.4	1.019 1.020 -0.1	1.283 1.284 -0.1	1.269 1.269 0.0	1.016 1.015 0.1	1.382 1.380 0.1	1.032 1.032 0.1	1.373 1.371 0.3	1.014 1.013 0.1	1.267 1.272 -0.5	1.282 1.292 -1.0	1.015 1.021 -0.6	1.209 1.207 0.1	0.356 0.356 0.0
G	0.349 0.349 0.1	1.079 1.077 0.2	1.090 1.090 0.0	1.011 1.013 -0.2	1.403 1.406 -0.3	1.242 1.246 -0.4	1.272 1.274 -0.2	1.373 1.372 0.1	1.268 1.261 0.7	1.250 1.237 1.3	1.406 1.404 0.2	1.013 1.014 -0.2	1.117 1.114 0.3	1.091 1.078 1.3	0.352 0.351 0.0
F	0.336 0.335 0.1	1.064 1.062 0.2	1.183 1.183 0.0	1.362 1.363 -0.2	1.266 1.272 -0.6	1.242 1.251 -0.9	1.251 1.258 -0.7	1.013 1.015 -0.2	1.240 1.237 0.3	1.241 1.234 0.7	1.268 1.266 0.2	1.369 1.369 0.0	1.197 1.196 0.1	1.074 1.075 0.0	0.338 0.344 -0.6
E	0.277 0.277 0.1	1.081 1.078 0.3	1.178 1.175 0.2	1.231 1.231 -0.1	1.236 1.243 -0.7	1.269 1.283 -1.4	1.406 1.417 -1.1	1.267 1.277 -0.9	1.402 1.404 -0.2	1.265 1.264 0.1	1.235 1.235 0.0	1.237 1.240 -0.2	1.187 1.191 -0.4	1.089 1.097 -0.7	0.280 0.285 -0.4
D		0.510 0.508 0.2	1.204 1.198 0.7	1.237 1.232 0.5	1.238 1.239 -0.1	1.370 1.376 -0.6	1.014 1.020 -0.6	1.282 1.290 -0.8	1.012 1.016 -0.4	1.361 1.359 0.2	1.231 1.231 -0.1	1.237 1.242 -0.5	1.211 1.219 -0.8	0.517 0.522 -0.5	
C		0.280 0.278 0.2	1.036 1.027 0.9	1.211 1.199 1.2	1.187 1.185 0.3	1.198 1.199 -0.2	1.117 1.120 -0.3	1.017 1.019 -0.2	1.090 1.086 0.4	1.183 1.171 1.2	1.178 1.179 -0.1	1.205 1.212 -0.7	1.037 1.049 -1.3	0.281 0.288 -0.7	
B			0.282 0.280 0.2	0.517 0.513 0.3	1.090 1.087 0.3	1.075 1.074 0.0	1.091 1.092 0.0	1.209 1.208 0.1	1.078 1.074 0.4	1.064 1.061 0.3	1.081 1.090 -0.9	0.513 0.517 -0.4	0.281 0.285 -0.4		
A					0.280 0.279 0.1	0.339 0.339 0.0	0.351 0.351 0.0	0.356 0.356 0.0	0.349 0.348 0.1	0.335 0.336 -0.1	0.278 0.281 -0.3				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure G2 10.4.5-13: Plant G2 MOC 3 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.312 0.311 0.1	0.395 0.393 0.2	0.414 0.412 0.2	0.409 0.408 0.2	0.412 0.410 0.2	0.391 0.389 0.2	0.307 0.305 0.2				
O			0.308 0.310 -0.2	0.537 0.537 0.0	1.077 1.072 0.5	1.159 1.149 1.0	1.192 1.184 0.7	1.235 1.230 0.6	1.185 1.180 0.6	1.146 1.137 0.9	1.058 1.047 1.0	0.533 0.527 0.5	0.306 0.303 0.3	Calculated Power Measured Power Difference (C-M)*100	
N		0.307 0.311 -0.5	1.028 1.033 -0.4	1.224 1.223 0.1	1.130 1.126 0.4	1.172 1.161 1.1	1.129 1.126 0.2	1.041 1.042 -0.1	1.123 1.119 0.3	1.157 1.149 0.8	1.097 1.084 1.3	1.214 1.199 1.5	1.028 1.018 1.1	0.307 0.305 0.2	
M		0.531 0.534 -0.3	1.214 1.216 -0.2	1.158 1.157 0.1	1.147 1.146 0.1	1.388 1.385 0.3	1.039 1.047 -0.8	1.366 1.370 -0.4	1.030 1.030 0.0	1.378 1.369 0.9	1.138 1.120 1.8	1.157 1.144 1.4	1.224 1.215 0.9	0.538 0.536 0.2	
L	0.307 0.310 -0.3	1.057 1.061 -0.4	1.097 1.096 0.1	1.138 1.137 0.1	1.133 1.132 0.2	1.185 1.186 0.0	1.428 1.430 -0.2	1.240 1.244 -0.4	1.426 1.427 -0.1	1.183 1.183 0.0	1.133 1.127 0.6	1.147 1.143 0.4	1.130 1.128 0.2	1.077 1.076 0.1	0.312 0.313 -0.1
K	0.391 0.396 -0.5	1.146 1.147 -0.1	1.157 1.156 0.0	1.378 1.377 0.2	1.183 1.183 0.0	1.145 1.142 0.3	1.165 1.164 0.1	0.993 0.994 -0.1	1.171 1.173 -0.2	1.144 1.148 -0.4	1.185 1.191 -0.7	1.387 1.394 -0.7	1.172 1.177 -0.5	1.159 1.161 -0.3	0.395 0.396 -0.2
J	0.412 0.413 -0.1	1.186 1.180 0.6	1.123 1.123 0.0	1.033 1.036 -0.3	1.427 1.427 0.0	1.172 1.166 0.5	1.204 1.201 0.2	1.400 1.399 0.1	1.201 1.202 -0.1	1.163 1.168 -0.5	1.427 1.443 -1.6	1.038 1.060 -2.2	1.128 1.139 -1.1	1.191 1.198 -0.6	0.414 0.416 -0.2
H	0.410 0.411 -0.1	1.235 1.236 0.0	1.044 1.050 -0.7	1.366 1.373 -0.7	1.240 1.246 -0.6	0.993 0.995 -0.2	1.400 1.400 0.0	1.040 1.039 0.1	1.393 1.389 0.4	0.992 0.992 0.0	1.239 1.249 -1.0	1.365 1.383 -1.8	1.041 1.053 -1.2	1.235 1.239 -0.4	0.410 0.412 -0.2
G	0.414 0.415 -0.1	1.192 1.193 -0.2	1.129 1.133 -0.5	1.037 1.047 -1.0	1.427 1.437 -1.0	1.164 1.171 -0.7	1.201 1.205 -0.4	1.393 1.391 0.1	1.198 1.190 0.8	1.170 1.153 1.6	1.425 1.425 0.1	1.027 1.033 -0.6	1.122 1.126 -0.3	1.185 1.181 0.4	0.411 0.413 -0.2
F	0.395 0.395 0.0	1.159 1.158 0.1	1.172 1.174 -0.2	1.387 1.392 -0.5	1.185 1.195 -1.0	1.144 1.156 -1.1	1.170 1.178 -0.8	0.991 0.994 -0.3	1.163 1.159 0.4	1.144 1.135 0.9	1.182 1.181 0.1	1.377 1.378 -0.1	1.156 1.158 -0.2	1.146 1.148 -0.2	0.390 0.396 -0.6
E	0.311 0.311 0.0	1.076 1.074 0.3	1.130 1.127 0.3	1.147 1.148 -0.1	1.133 1.140 -0.7	1.183 1.199 -1.6	1.426 1.437 -1.2	1.240 1.250 -1.0	1.427 1.428 -0.2	1.185 1.184 0.1	1.133 1.132 0.0	1.138 1.141 -0.3	1.097 1.099 -0.2	1.057 1.063 -0.6	0.307 0.311 -0.4
D		0.535 0.532 0.3	1.223 1.212 1.2	1.157 1.147 1.0	1.138 1.138 0.1	1.378 1.382 -0.4	1.028 1.035 -0.7	1.365 1.373 -0.8	1.039 1.045 -0.6	1.387 1.383 0.4	1.147 1.147 0.0	1.157 1.160 -0.3	1.214 1.220 -0.7	0.531 0.536 -0.5	
C		0.307 0.304 0.3	1.028 1.012 1.7	1.214 1.192 2.2	1.097 1.089 0.8	1.156 1.155 0.1	1.122 1.124 -0.1	1.042 1.044 -0.2	1.129 1.124 0.4	1.172 1.158 1.4	1.130 1.128 0.2	1.224 1.228 -0.4	1.028 1.038 -1.0	0.306 0.313 -0.7	
B			0.307 0.302 0.4	0.531 0.525 0.6	1.057 1.050 0.8	1.146 1.141 0.5	1.185 1.183 0.2	1.235 1.231 0.4	1.192 1.184 0.7	1.159 1.150 0.9	1.077 1.079 -0.2	0.538 0.541 -0.3	0.308 0.312 -0.3		
A					0.307 0.305 0.2	0.391 0.390 0.1	0.410 0.410 0.1	0.410 0.409 0.1	0.414 0.412 0.1	0.395 0.394 0.1	0.312 0.313 -0.1				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure G2 10.4.5-14: Plant G2 EOC 3 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.373 0.368 0.5	0.478 0.472 0.6	0.498 0.494 0.4	0.484 0.482 0.3	0.501 0.499 0.2	0.482 0.480 0.2	0.375 0.374 0.2				
O			0.367 0.366 0.0	0.600 0.596 0.4	1.105 1.090 1.5	1.239 1.221 1.8	1.263 1.251 1.2	1.251 1.243 0.8	1.276 1.270 0.6	1.249 1.242 0.7	1.111 1.104 0.7	0.604 0.601 0.4	0.367 0.364 0.2		
N		0.367 0.370 -0.3	1.071 1.069 0.1	1.261 1.255 0.7	1.116 1.106 1.0	1.143 1.128 1.5	1.092 1.085 0.7	1.035 1.033 0.1	1.122 1.120 0.2	1.155 1.151 0.4	1.122 1.114 0.8	1.265 1.254 1.1	1.071 1.063 0.8	0.365 0.364 0.1	
M		0.603 0.602 0.0	1.265 1.262 0.3	1.140 1.136 0.4	1.100 1.096 0.5	1.320 1.314 0.6	1.004 1.009 -0.5	1.318 1.321 -0.3	1.006 1.007 -0.1	1.327 1.324 0.3	1.105 1.095 1.0	1.140 1.132 0.8	1.261 1.256 0.5	0.600 0.600 0.1	
L	0.375 0.375 0.0	1.111 1.107 0.4	1.122 1.118 0.4	1.105 1.102 0.3	1.071 1.068 0.3	1.103 1.101 0.2	1.330 1.331 -0.1	1.152 1.156 -0.4	1.333 1.337 -0.4	1.105 1.112 -0.6	1.071 1.072 -0.1	1.101 1.102 -0.1	1.116 1.117 -0.1	1.105 1.107 -0.2	0.373 0.374 -0.1
K	0.482 0.482 0.0	1.249 1.239 1.0	1.155 1.149 0.7	1.327 1.323 0.4	1.105 1.104 0.2	1.061 1.058 0.4	1.076 1.075 0.1	0.942 0.944 -0.2	1.082 1.087 -0.5	1.061 1.070 -0.8	1.103 1.114 -1.1	1.321 1.332 -1.2	1.143 1.150 -0.7	1.239 1.243 -0.4	0.478 0.480 -0.2
J	0.501 0.498 0.3	1.276 1.258 1.8	1.122 1.116 0.6	1.008 1.009 -0.1	1.333 1.333 0.0	1.083 1.077 0.5	1.112 1.110 0.1	1.309 1.310 -0.1	1.111 1.115 -0.4	1.076 1.085 -0.8	1.331 1.352 -2.1	1.003 1.028 -2.5	1.092 1.102 -1.0	1.264 1.269 -0.6	0.498 0.500 -0.2
H	0.485 0.483 0.2	1.251 1.245 0.6	1.037 1.040 -0.3	1.318 1.326 -0.8	1.152 1.159 -0.7	0.942 0.946 -0.3	1.309 1.311 -0.2	0.990 0.991 -0.1	1.306 1.306 0.0	0.943 0.946 -0.3	1.153 1.165 -1.3	1.318 1.338 -1.9	1.035 1.044 -1.0	1.251 1.253 -0.2	0.485 0.487 -0.1
G	0.498 0.497 0.1	1.263 1.262 0.2	1.092 1.094 -0.2	1.002 1.014 -1.3	1.331 1.345 -1.4	1.076 1.086 -0.9	1.111 1.117 -0.6	1.306 1.308 -0.2	1.110 1.106 0.4	1.082 1.073 1.0	1.334 1.336 -0.3	1.004 1.010 -0.6	1.122 1.123 0.0	1.276 1.266 1.1	0.501 0.502 -0.1
F	0.478 0.478 0.0	1.239 1.237 0.2	1.143 1.145 -0.2	1.321 1.329 -0.8	1.103 1.117 -1.4	1.061 1.077 -1.6	1.083 1.093 -1.0	0.942 0.946 -0.4	1.076 1.075 0.1	1.062 1.057 0.5	1.106 1.106 -0.1	1.328 1.330 -0.2	1.156 1.157 -0.1	1.250 1.250 -0.1	0.481 0.488 -0.7
E	0.372 0.372 0.1	1.105 1.102 0.3	1.116 1.114 0.2	1.101 1.104 -0.4	1.072 1.084 -1.2	1.106 1.128 -2.2	1.333 1.347 -1.4	1.153 1.161 -0.9	1.331 1.334 -0.3	1.103 1.103 0.0	1.072 1.072 0.0	1.105 1.108 -0.3	1.122 1.127 -0.5	1.111 1.119 -0.8	0.375 0.381 -0.5
D		0.598 0.594 0.3	1.261 1.251 1.0	1.140 1.133 0.7	1.105 1.108 -0.3	1.328 1.336 -0.8	1.005 1.012 -0.8	1.318 1.327 -0.8	1.004 1.011 -0.7	1.321 1.317 0.4	1.101 1.100 0.1	1.140 1.143 -0.3	1.265 1.273 -0.8	0.603 0.610 -0.7	
C		0.365 0.362 0.4	1.071 1.055 1.5	1.265 1.245 2.0	1.122 1.118 0.5	1.155 1.157 -0.1	1.122 1.124 -0.2	1.035 1.037 -0.1	1.092 1.085 0.7	1.143 1.125 1.8	1.116 1.111 0.5	1.261 1.264 -0.3	1.071 1.082 -1.1	0.366 0.376 -1.0	
B			0.367 0.363 0.4	0.603 0.597 0.6	1.111 1.106 0.6	1.249 1.246 0.3	1.276 1.274 0.2	1.251 1.246 0.5	1.264 1.252 1.2	1.239 1.223 1.6	1.105 1.099 0.6	0.601 0.602 -0.1	0.367 0.371 -0.4		
A					0.375 0.373 0.1	0.483 0.481 0.1	0.500 0.499 0.1	0.485 0.484 0.2	0.497 0.494 0.4	0.478 0.474 0.4	0.373 0.371 0.2				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

Figure G2 10.4.5-15: Plant G2 BOC 4 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.267 0.271 -0.4	0.357 0.360 -0.3	0.347 0.349 -0.1	0.367 0.368 -0.1	0.345 0.346 -0.1	0.363 0.363 -0.1	0.264 0.265 -0.1				
O			0.324 0.328 -0.4	0.948 0.958 -1.0	0.983 0.996 -1.3	1.270 1.278 -0.8	1.111 1.114 -0.3	1.196 1.198 -0.3	1.121 1.123 -0.2	1.261 1.264 -0.3	0.987 0.989 -0.2	0.956 0.960 -0.4	0.328 0.329 -0.1	Calculated Power Measured Power Difference (C-M)*100	
N		0.324 0.332 -0.8	0.926 0.936 -1.0	1.318 1.327 -0.9	1.208 1.214 -0.6	1.197 1.197 0.0	0.913 0.914 -0.1	0.905 0.906 -0.1	0.945 0.946 -0.1	1.213 1.214 -0.1	1.221 1.223 -0.2	1.335 1.341 -0.6	0.941 0.945 -0.4	0.325 0.325 -0.1	
M		0.949 0.956 -0.8	1.323 1.330 -0.6	1.232 1.233 -0.1	1.028 1.028 0.0	1.329 1.330 -0.1	1.205 1.207 -0.2	1.301 1.301 0.0	1.215 1.215 0.0	1.338 1.340 -0.2	1.036 1.030 0.6	1.238 1.237 0.1	1.326 1.327 -0.1	0.952 0.953 0.0	
L	0.263 0.266 -0.2	0.983 0.987 -0.4	1.216 1.217 -0.1	1.033 1.026 0.6	1.268 1.264 0.4	1.013 1.012 0.1	1.384 1.384 0.0	1.064 1.061 0.4	1.381 1.382 -0.1	1.016 1.025 -0.9	1.270 1.271 -0.1	1.031 1.028 0.3	1.211 1.210 0.2	0.986 0.984 0.2	0.268 0.268 0.1
K	0.363 0.366 -0.4	1.259 1.262 -0.3	1.210 1.207 0.4	1.336 1.330 0.6	1.012 1.009 0.3	1.158 1.159 -0.1	1.235 1.236 -0.1	1.212 1.213 0.0	1.232 1.233 -0.1	1.159 1.163 -0.5	1.014 1.013 0.1	1.331 1.326 0.5	1.199 1.195 0.5	1.272 1.269 0.4	0.359 0.358 0.1
J	0.344 0.343 0.1	1.120 1.114 0.6	0.944 0.935 0.9	1.214 1.203 1.1	1.381 1.374 0.7	1.233 1.236 -0.3	1.006 1.008 -0.2	1.321 1.321 -0.1	1.004 1.004 0.0	1.235 1.233 0.1	1.385 1.378 0.7	1.207 1.194 1.2	0.914 0.908 0.6	1.113 1.108 0.4	0.348 0.347 0.1
H	0.366 0.363 0.3	1.195 1.184 1.1	0.903 0.887 1.6	1.302 1.280 2.1	1.065 1.056 1.0	1.215 1.213 0.3	1.329 1.329 0.0	0.973 0.973 0.0	1.321 1.320 0.1	1.213 1.210 0.3	1.065 1.059 0.6	1.302 1.289 1.3	0.905 0.895 1.0	1.196 1.193 0.3	0.366 0.366 0.1
G	0.348 0.344 0.3	1.112 1.101 1.1	0.914 0.902 1.2	1.207 1.184 2.3	1.386 1.373 1.3	1.238 1.236 0.2	1.009 1.009 -0.1	1.329 1.330 0.0	1.009 1.009 0.1	1.233 1.231 0.3	1.382 1.378 0.4	1.216 1.210 0.5	0.946 0.943 0.3	1.121 1.124 -0.3	0.345 0.346 -0.1
F	0.359 0.356 0.3	1.273 1.263 1.1	1.200 1.189 1.1	1.332 1.322 1.0	1.015 1.014 0.1	1.162 1.169 -0.7	1.236 1.240 -0.4	1.216 1.218 -0.2	1.237 1.236 0.1	1.161 1.160 0.1	1.013 1.012 0.1	1.339 1.340 -0.1	1.213 1.218 -0.5	1.262 1.272 -1.1	0.362 0.367 -0.5
E	0.269 0.267 0.2	0.986 0.979 0.7	1.212 1.205 0.7	1.032 1.028 0.4	1.272 1.278 -0.6	1.016 1.030 -1.4	1.383 1.391 -0.7	1.066 1.068 -0.2	1.387 1.384 0.3	1.015 1.014 0.1	1.271 1.274 -0.2	1.036 1.041 -0.5	1.221 1.231 -1.0	0.987 0.997 -1.0	0.265 0.268 -0.4
D		0.953 0.947 0.6	1.327 1.319 0.7	1.239 1.234 0.4	1.037 1.038 -0.1	1.340 1.345 -0.6	1.216 1.219 -0.3	1.303 1.298 0.5	1.208 1.195 1.3	1.332 1.330 0.2	1.031 1.035 -0.4	1.238 1.249 -1.0	1.335 1.351 -1.6	0.956 0.970 -1.4	
C		0.327 0.325 0.2	0.942 0.936 0.5	1.335 1.328 0.7	1.221 1.220 0.1	1.214 1.214 -0.1	0.946 0.946 0.0	0.906 0.902 0.3	0.914 0.910 0.5	1.200 1.201 -0.1	1.212 1.221 -0.9	1.327 1.342 -1.5	0.941 0.957 -1.6	0.328 0.338 -1.0	
B			0.329 0.328 0.2	0.957 0.953 0.3	0.987 0.986 0.1	1.262 1.262 0.0	1.122 1.121 0.0	1.197 1.196 0.1	1.113 1.114 -0.1	1.273 1.282 -0.9	0.986 1.001 -1.5	0.953 0.966 -1.3	0.326 0.332 -0.6		
A					0.263 0.263 0.0	0.363 0.363 0.0	0.346 0.345 0.0	0.368 0.368 0.0	0.348 0.349 -0.1	0.358 0.361 -0.3	0.269 0.273 -0.4				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.6

Figure G2 10.4.5-16: Plant G2 MOC 4 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.275 0.275 0.0	0.366 0.366 0.1	0.372 0.371 0.1	0.390 0.389 0.1	0.369 0.368 0.1	0.367 0.365 0.2	0.271 0.269 0.2				
O			0.339 0.341 -0.1	0.923 0.923 0.0	0.923 0.923 0.1	1.187 1.183 0.5	1.131 1.128 0.4	1.176 1.173 0.2	1.136 1.133 0.3	1.176 1.171 0.6	0.925 0.917 0.7	0.927 0.918 1.0	0.342 0.338 0.4	Calculated Power Measured Power Difference (C-M)*100	
N		0.339 0.344 -0.4	0.921 0.923 -0.3	1.321 1.319 0.1	1.147 1.144 0.3	1.139 1.134 0.5	0.918 0.916 0.2	0.920 0.920 -0.1	0.943 0.942 0.0	1.150 1.145 0.5	1.155 1.144 1.1	1.332 1.315 1.7	0.932 0.920 1.1	0.339 0.335 0.4	
M		0.923 0.925 -0.1	1.325 1.323 0.1	1.197 1.193 0.4	1.025 1.022 0.2	1.384 1.383 0.1	1.209 1.213 -0.4	1.373 1.379 -0.6	1.215 1.220 -0.4	1.390 1.388 0.1	1.029 1.013 1.7	1.201 1.183 1.8	1.325 1.309 1.6	0.925 0.915 1.0	
L	0.270 0.271 0.0	0.923 0.922 0.1	1.153 1.150 0.4	1.028 1.021 0.7	1.342 1.338 0.4	1.045 1.048 -0.3	1.446 1.453 -0.8	1.081 1.090 -0.9	1.442 1.453 -1.1	1.047 1.061 -1.4	1.343 1.339 0.4	1.026 1.016 0.9	1.148 1.137 1.1	0.924 0.916 0.9	0.276 0.273 0.2
K	0.367 0.367 0.0	1.176 1.172 0.4	1.149 1.145 0.4	1.389 1.384 0.5	1.044 1.045 -0.1	1.152 1.161 -0.9	1.214 1.225 -1.1	1.201 1.212 -1.0	1.211 1.222 -1.1	1.152 1.163 -1.1	1.046 1.047 -0.2	1.384 1.376 0.8	1.140 1.131 0.9	1.187 1.177 1.1	0.368 0.365 0.3
J	0.368 0.366 0.2	1.136 1.129 0.7	0.942 0.936 0.6	1.215 1.210 0.5	1.442 1.444 -0.2	1.212 1.228 -1.5	1.026 1.038 -1.2	1.395 1.408 -1.3	1.024 1.033 -0.8	1.214 1.220 -0.7	1.446 1.445 0.1	1.210 1.201 0.8	0.918 0.910 0.8	1.131 1.122 0.9	0.372 0.370 0.3
H	0.389 0.387 0.2	1.176 1.167 0.9	0.918 0.909 0.9	1.373 1.361 1.2	1.081 1.080 0.1	1.203 1.211 -0.8	1.402 1.415 -1.3	1.031 1.041 -0.9	1.395 1.406 -1.1	1.202 1.208 -0.6	1.081 1.081 0.0	1.374 1.363 1.0	0.920 0.909 1.1	1.176 1.167 0.9	0.389 0.387 0.2
G	0.372 0.370 0.3	1.131 1.123 0.9	0.918 0.910 0.8	1.210 1.196 1.4	1.447 1.444 0.2	1.216 1.225 -0.9	1.028 1.038 -1.0	1.403 1.416 -1.3	1.029 1.039 -1.0	1.212 1.223 -1.0	1.442 1.445 -0.2	1.215 1.212 0.3	0.943 0.938 0.4	1.136 1.133 0.3	0.368 0.367 0.1
F	0.368 0.365 0.3	1.188 1.180 0.9	1.140 1.133 0.7	1.385 1.380 0.4	1.046 1.053 -0.7	1.154 1.172 -1.7	1.214 1.230 -1.6	1.204 1.216 -1.3	1.215 1.226 -1.0	1.154 1.161 -0.7	1.044 1.047 -0.4	1.390 1.391 -0.1	1.150 1.151 -0.1	1.176 1.177 -0.1	0.367 0.367 0.0
E	0.276 0.274 0.2	0.925 0.918 0.7	1.148 1.141 0.7	1.026 1.025 0.1	1.344 1.357 -1.4	1.046 1.071 -2.4	1.443 1.463 -2.0	1.081 1.094 -1.3	1.447 1.454 -0.7	1.046 1.050 -0.4	1.344 1.347 -0.4	1.029 1.033 -0.4	1.155 1.159 -0.4	0.924 0.928 -0.4	0.271 0.272 -0.1
D		0.925 0.917 0.8	1.325 1.312 1.3	1.201 1.192 0.9	1.029 1.032 -0.3	1.390 1.402 -1.2	1.216 1.226 -1.1	1.374 1.379 -0.5	1.210 1.205 0.5	1.385 1.385 0.0	1.026 1.029 -0.4	1.201 1.207 -0.6	1.332 1.340 -0.9	0.927 0.935 -0.7	
C		0.341 0.337 0.4	0.932 0.920 1.2	1.332 1.313 1.9	1.155 1.152 0.4	1.150 1.153 -0.3	0.943 0.946 -0.3	0.920 0.920 0.0	0.918 0.914 0.4	1.140 1.137 0.3	1.148 1.152 -0.4	1.325 1.333 -0.8	0.932 0.942 -1.0	0.342 0.349 -0.7	
B			0.343 0.339 0.4	0.927 0.919 0.9	0.924 0.921 0.3	1.176 1.176 0.0	1.136 1.137 -0.1	1.176 1.176 0.0	1.132 1.130 0.2	1.187 1.188 0.0	0.924 0.931 -0.6	0.925 0.931 -0.7	0.340 0.344 -0.4		
A					0.270 0.269 0.1	0.367 0.367 0.0	0.369 0.369 0.0	0.391 0.391 0.0	0.372 0.372 0.0	0.366 0.368 -0.1	0.276 0.278 -0.2				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure G2 10.4.5-17: Plant G2 EOC 4 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.320 0.320 0.0	0.431 0.431 0.0	0.459 0.459 0.0	0.477 0.479 -0.1	0.454 0.456 -0.1	0.429 0.430 -0.1	0.316 0.316 0.0				
O			0.383 0.386 -0.3	0.964 0.966 -0.2	0.947 0.946 0.1	1.234 1.231 0.3	1.294 1.294 0.0	1.293 1.295 -0.2	1.294 1.298 -0.3	1.227 1.228 -0.1	0.959 0.957 0.1	0.975 0.969 0.6	0.387 0.384 0.3	Calculated Power Measured Power Difference (C-M)*100	
N		0.385 0.390 -0.5	0.965 0.971 -0.6	1.344 1.349 -0.5	1.095 1.095 -0.1	1.135 1.133 0.2	0.994 0.996 -0.2	0.996 1.001 -0.5	0.998 1.004 -0.6	1.149 1.154 -0.5	1.133 1.131 0.2	1.361 1.348 1.3	0.972 0.962 1.0	0.381 0.378 0.3	
M		0.975 0.978 -0.4	1.360 1.365 -0.6	1.119 1.125 -0.6	0.887 0.892 -0.5	1.320 1.326 -0.6	1.204 1.212 -0.8	1.426 1.437 -1.1	1.207 1.219 -1.2	1.329 1.341 -1.2	0.899 0.899 0.0	1.119 1.111 0.8	1.343 1.331 1.2	0.963 0.954 0.8	
L	0.317 0.317 0.0	0.959 0.959 0.0	1.134 1.135 -0.1	0.899 0.905 -0.6	0.810 0.818 -0.8	0.911 0.920 -0.9	1.421 1.436 -1.5	1.081 1.095 -1.4	1.420 1.440 -2.1	0.913 0.936 -2.3	0.810 0.820 -1.0	0.886 0.884 0.2	1.094 1.085 0.9	0.946 0.938 0.7	0.320 0.318 0.2
K	0.430 0.428 0.1	1.228 1.217 1.0	1.150 1.144 0.5	1.330 1.330 0.0	0.911 0.918 -0.6	1.049 1.065 -1.6	1.169 1.188 -1.8	1.178 1.195 -1.7	1.168 1.186 -1.8	1.049 1.067 -1.8	0.910 0.917 -0.7	1.319 1.315 0.4	1.134 1.127 0.7	1.233 1.222 1.1	0.432 0.429 0.4
J	0.453 0.448 0.6	1.295 1.272 2.2	0.998 0.987 1.1	1.207 1.202 0.5	1.420 1.426 -0.6	1.168 1.191 -2.3	1.031 1.049 -1.8	1.433 1.453 -1.9	1.031 1.044 -1.3	1.169 1.180 -1.1	1.421 1.423 -0.2	1.204 1.197 0.7	0.993 0.985 0.9	1.293 1.280 1.4	0.459 0.455 0.4
H	0.477 0.470 0.6	1.293 1.273 2.0	0.994 0.980 1.5	1.425 1.408 1.7	1.081 1.080 0.1	1.179 1.190 -1.1	1.437 1.455 -1.8	1.071 1.084 -1.3	1.433 1.449 -1.5	1.178 1.187 -0.9	1.081 1.082 -0.1	1.425 1.412 1.3	0.996 0.980 1.5	1.292 1.275 1.7	0.476 0.471 0.5
G	0.459 0.453 0.6	1.293 1.275 1.9	0.993 0.980 1.4	1.204 1.183 2.0	1.421 1.415 0.5	1.170 1.180 -1.0	1.032 1.044 -1.3	1.437 1.454 -1.6	1.034 1.046 -1.2	1.168 1.180 -1.2	1.419 1.421 -0.1	1.207 1.200 0.7	0.998 0.986 1.2	1.294 1.276 1.8	0.453 0.449 0.4
F	0.432 0.427 0.6	1.234 1.217 1.8	1.134 1.120 1.4	1.319 1.308 1.1	0.910 0.914 -0.4	1.050 1.068 -1.8	1.168 1.185 -1.7	1.178 1.191 -1.3	1.169 1.180 -1.0	1.050 1.057 -0.7	0.910 0.911 -0.1	1.329 1.324 0.5	1.149 1.142 0.6	1.227 1.218 0.9	0.428 0.428 0.1
E	0.320 0.316 0.4	0.946 0.932 1.3	1.094 1.078 1.5	0.886 0.880 0.6	0.809 0.819 -0.9	0.912 0.937 -2.6	1.419 1.439 -2.0	1.081 1.091 -1.1	1.420 1.425 -0.4	0.910 0.912 -0.2	0.810 0.811 -0.1	0.898 0.898 0.0	1.133 1.131 0.2	0.958 0.957 0.1	0.317 0.317 0.0
D		0.963 0.947 1.6	1.343 1.321 2.3	1.119 1.103 1.5	0.898 0.897 0.1	1.329 1.338 -0.9	1.206 1.215 -0.8	1.425 1.426 -0.1	1.204 1.195 0.9	1.319 1.315 0.4	0.886 0.886 0.0	1.119 1.120 -0.1	1.361 1.363 -0.2	0.975 0.977 -0.2	
C		0.383 0.377 0.7	0.972 0.952 2.0	1.360 1.333 2.8	1.133 1.124 0.9	1.149 1.148 0.1	0.997 0.998 -0.1	0.996 0.993 0.2	0.993 0.987 0.6	1.134 1.129 0.5	1.093 1.092 0.1	1.343 1.345 -0.2	0.972 0.977 -0.5	0.387 0.392 -0.5	
B			0.388 0.381 0.7	0.975 0.960 1.5	0.958 0.950 0.8	1.226 1.221 0.5	1.294 1.290 0.4	1.292 1.287 0.5	1.293 1.288 0.5	1.233 1.230 0.3	0.945 0.949 -0.3	0.963 0.965 -0.3	0.383 0.385 -0.3		
A					0.315 0.313 0.2	0.429 0.427 0.2	0.454 0.453 0.1	0.478 0.476 0.1	0.459 0.458 0.1	0.431 0.431 0.0	0.320 0.321 -0.1				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 1.0

Figure G2 10.4.5-18: Plant G2 BOC 5 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.279 0.282 -0.3	0.397 0.399 -0.2	0.413 0.412 0.1	0.400 0.398 0.2	0.418 0.415 0.3	0.383 0.380 0.3	0.272 0.270 0.3				
O			0.312 0.315 -0.2	0.643 0.646 -0.3	1.211 1.221 -1.0	1.051 1.052 0.0	1.204 1.198 0.6	1.283 1.274 0.9	1.216 1.206 1.0	1.050 1.039 1.0	1.201 1.188 1.3	0.610 0.604 0.6	0.308 0.305 0.3	Calculated Power Measured Power Difference (C-M)*100	
N		0.309 0.315 -0.6	1.158 1.163 -0.5	1.344 1.343 0.1	1.268 1.266 0.3	1.240 1.232 0.7	1.147 1.140 0.7	0.948 0.943 0.5	1.186 1.176 1.0	1.252 1.239 1.3	1.264 1.247 1.7	1.333 1.320 1.4	1.158 1.146 1.2	0.314 0.311 0.3	
M		0.612 0.614 -0.2	1.338 1.334 0.3	1.051 1.042 0.9	1.266 1.257 0.9	1.360 1.352 0.8	1.000 0.998 0.2	1.081 1.076 0.4	1.013 1.006 0.6	1.371 1.355 1.7	1.269 1.242 2.6	1.049 1.034 1.6	1.352 1.336 1.5	0.648 0.642 0.6	
L	0.274 0.276 -0.2	1.205 1.206 -0.1	1.268 1.261 0.7	1.272 1.251 2.1	0.958 0.949 0.9	1.173 1.169 0.4	1.255 1.253 0.2	0.988 0.987 0.1	1.260 1.254 0.6	1.184 1.175 0.9	0.965 0.951 1.3	1.292 1.275 1.7	1.286 1.272 1.5	1.225 1.212 1.2	0.283 0.280 0.2
K	0.386 0.390 -0.4	1.056 1.058 -0.2	1.256 1.252 0.4	1.373 1.364 0.9	1.182 1.179 0.3	0.990 0.992 -0.2	1.181 1.184 -0.3	1.396 1.394 0.2	1.182 1.179 0.3	0.994 0.988 0.5	1.187 1.177 1.0	1.388 1.373 1.5	1.260 1.248 1.2	1.066 1.057 0.9	0.404 0.402 0.3
J	0.424 0.426 -0.2	1.224 1.226 -0.1	1.189 1.186 0.4	1.014 1.013 0.2	1.261 1.263 -0.2	1.182 1.192 -1.0	0.956 0.962 -0.6	1.197 1.199 -0.2	0.959 0.959 0.1	1.185 1.181 0.4	1.264 1.257 0.7	1.011 1.005 0.6	1.161 1.150 1.1	1.221 1.213 0.8	0.427 0.425 0.2
H	0.401 0.402 -0.1	1.288 1.286 0.2	0.950 0.946 0.4	1.081 1.080 0.1	0.988 0.992 -0.5	1.396 1.402 -0.7	1.197 1.203 -0.6	0.864 0.867 -0.2	1.204 1.203 0.1	1.401 1.395 0.6	0.992 0.989 0.3	1.087 1.080 0.6	0.955 0.949 0.7	1.294 1.289 0.5	0.405 0.404 0.0
G	0.414 0.415 -0.1	1.205 1.206 -0.1	1.148 1.148 0.0	1.000 1.004 -0.4	1.254 1.261 -0.8	1.180 1.189 -0.9	0.958 0.965 -0.7	1.203 1.208 -0.5	0.962 0.962 0.0	1.183 1.178 0.6	1.262 1.258 0.3	1.015 1.014 0.1	1.190 1.190 0.0	1.221 1.227 -0.6	0.415 0.417 -0.2
F	0.397 0.399 -0.2	1.052 1.055 -0.3	1.239 1.244 -0.5	1.359 1.365 -0.7	1.172 1.182 -1.0	0.989 1.000 -1.1	1.181 1.192 -1.1	1.398 1.406 -0.8	1.183 1.186 -0.3	0.991 0.990 0.1	1.183 1.183 0.0	1.372 1.373 -0.1	1.254 1.258 -0.4	1.051 1.056 -0.6	0.383 0.384 -0.2
E	0.279 0.280 -0.2	1.210 1.216 -0.6	1.267 1.274 -0.7	1.264 1.274 -1.0	0.957 0.968 -1.1	1.181 1.198 -1.7	1.259 1.274 -1.5	0.988 1.001 -1.2	1.256 1.262 -0.5	1.176 1.178 -0.2	0.959 0.961 -0.2	1.269 1.273 -0.4	1.264 1.270 -0.5	1.202 1.208 -0.6	0.273 0.275 -0.2
D		0.640 0.645 -0.5	1.341 1.351 -1.0	1.049 1.059 -1.0	1.270 1.283 -1.3	1.371 1.384 -1.4	1.013 1.024 -1.1	1.082 1.091 -0.9	1.002 1.005 -0.3	1.363 1.363 0.1	1.270 1.273 -0.3	1.052 1.057 -0.5	1.334 1.343 -0.9	0.611 0.616 -0.5	
C		0.311 0.314 -0.3	1.153 1.162 -1.0	1.335 1.347 -1.2	1.266 1.277 -1.1	1.253 1.264 -1.1	1.187 1.196 -0.8	0.951 0.955 -0.4	1.152 1.148 0.4	1.244 1.237 0.7	1.273 1.277 -0.4	1.349 1.357 -0.8	1.156 1.167 -1.1	0.308 0.314 -0.6	
B			0.308 0.311 -0.3	0.611 0.617 -0.6	1.202 1.212 -1.0	1.050 1.058 -0.8	1.218 1.225 -0.7	1.289 1.292 -0.3	1.213 1.212 0.1	1.058 1.059 -0.1	1.216 1.228 -1.2	0.645 0.651 -0.6	0.314 0.318 -0.4		
A					0.273 0.275 -0.3	0.382 0.386 -0.3	0.414 0.417 -0.3	0.402 0.404 -0.2	0.425 0.426 -0.1	0.402 0.404 -0.2	0.280 0.284 -0.3				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.8

Figure G2 10.4.5-19: Plant G2 MOC 5 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.300 0.302 -0.2	0.429 0.430 -0.1	0.454 0.453 0.1	0.439 0.438 0.2	0.460 0.458 0.2	0.416 0.414 0.3	0.295 0.293 0.2				
O			0.347 0.352 -0.4	0.671 0.675 -0.4	1.171 1.178 -0.7	1.039 1.039 0.0	1.250 1.245 0.5	1.273 1.265 0.8	1.264 1.255 0.9	1.042 1.034 0.9	1.168 1.158 1.1	0.640 0.635 0.5	0.343 0.340 0.2	Calculated Power Measured Power Difference (C-M)*100	
N		0.344 0.354 -1.0	1.179 1.190 -1.1	1.392 1.395 -0.3	1.227 1.227 0.1	1.205 1.199 0.5	1.132 1.126 0.6	0.950 0.946 0.4	1.171 1.163 0.8	1.220 1.209 1.1	1.226 1.213 1.4	1.382 1.370 1.2	1.176 1.166 1.0	0.348 0.346 0.3	
M		0.642 0.646 -0.5	1.387 1.390 -0.2	1.061 1.057 0.4	1.242 1.236 0.6	1.401 1.395 0.6	0.995 0.993 0.2	1.067 1.063 0.3	1.007 1.001 0.5	1.413 1.397 1.5	1.244 1.221 2.3	1.057 1.044 1.3	1.394 1.380 1.3	0.672 0.667 0.5	
L	0.296 0.299 -0.2	1.171 1.174 -0.3	1.230 1.228 0.3	1.248 1.234 1.4	0.963 0.957 0.6	1.148 1.145 0.3	1.214 1.212 0.2	0.977 0.976 0.1	1.217 1.212 0.5	1.156 1.148 0.8	0.966 0.954 1.1	1.258 1.245 1.4	1.236 1.225 1.1	1.176 1.166 1.0	0.302 0.300 0.2
K	0.419 0.423 -0.4	1.047 1.049 -0.2	1.222 1.220 0.3	1.415 1.407 0.8	1.156 1.154 0.3	0.974 0.976 -0.2	1.146 1.148 -0.1	1.410 1.408 0.3	1.146 1.143 0.3	0.975 0.971 0.4	1.156 1.148 0.7	1.420 1.408 1.2	1.215 1.206 0.9	1.046 1.038 0.8	0.433 0.431 0.2
J	0.466 0.468 -0.1	1.271 1.270 0.1	1.174 1.169 0.5	1.008 1.006 0.2	1.219 1.219 0.0	1.147 1.154 -0.7	0.944 0.949 -0.4	1.157 1.158 0.0	0.946 0.945 0.1	1.147 1.144 0.3	1.217 1.213 0.4	1.000 0.998 0.2	1.138 1.129 0.9	1.260 1.252 0.8	0.466 0.464 0.2
H	0.440 0.441 0.0	1.276 1.272 0.4	0.951 0.945 0.6	1.067 1.064 0.3	0.977 0.980 -0.3	1.411 1.415 -0.4	1.158 1.162 -0.4	0.863 0.864 -0.1	1.162 1.160 0.2	1.413 1.406 0.7	0.978 0.976 0.2	1.069 1.064 0.5	0.952 0.945 0.7	1.277 1.271 0.6	0.442 0.441 0.1
G	0.455 0.455 -0.1	1.251 1.250 0.1	1.133 1.130 0.2	0.995 0.997 -0.2	1.213 1.218 -0.5	1.145 1.152 -0.7	0.945 0.951 -0.5	1.162 1.165 -0.3	0.948 0.947 0.1	1.146 1.139 0.8	1.218 1.214 0.4	1.007 1.006 0.2	1.172 1.170 0.3	1.265 1.267 -0.2	0.456 0.456 0.0
F	0.429 0.431 -0.2	1.040 1.042 -0.2	1.205 1.208 -0.3	1.401 1.406 -0.5	1.147 1.156 -0.9	0.974 0.984 -1.0	1.146 1.155 -0.9	1.412 1.417 -0.5	1.146 1.147 -0.1	0.974 0.972 0.2	1.155 1.154 0.1	1.413 1.412 0.1	1.220 1.221 -0.1	1.042 1.042 -0.1	0.415 0.413 0.2
E	0.300 0.302 -0.2	1.171 1.176 -0.5	1.227 1.233 -0.6	1.241 1.250 -0.9	0.962 0.973 -1.0	1.155 1.171 -1.6	1.217 1.230 -1.3	0.977 0.987 -1.0	1.214 1.217 -0.4	1.149 1.150 -0.1	0.963 0.964 -0.1	1.245 1.248 -0.3	1.227 1.231 -0.4	1.169 1.171 -0.3	0.295 0.295 0.0
D		0.667 0.672 -0.5	1.390 1.399 -0.9	1.060 1.069 -0.9	1.247 1.259 -1.2	1.414 1.426 -1.2	1.007 1.017 -1.0	1.067 1.074 -0.7	0.995 0.998 -0.3	1.403 1.402 0.1	1.244 1.247 -0.3	1.061 1.066 -0.5	1.384 1.393 -0.9	0.640 0.646 -0.6	
C		0.347 0.349 -0.3	1.175 1.184 -0.8	1.386 1.397 -1.1	1.229 1.239 -1.0	1.221 1.230 -1.0	1.172 1.179 -0.7	0.951 0.955 -0.4	1.135 1.131 0.4	1.207 1.199 0.7	1.230 1.234 -0.4	1.395 1.404 -0.9	1.177 1.191 -1.4	0.343 0.352 -0.9	
B			0.343 0.346 -0.3	0.641 0.647 -0.6	1.170 1.179 -0.9	1.042 1.050 -0.7	1.265 1.271 -0.6	1.276 1.278 -0.2	1.258 1.256 0.2	1.043 1.043 0.0	1.173 1.184 -1.1	0.671 0.678 -0.7	0.349 0.354 -0.5		
A					0.295 0.298 -0.3	0.416 0.419 -0.3	0.456 0.458 -0.3	0.441 0.442 -0.2	0.465 0.467 -0.1	0.432 0.435 -0.2	0.301 0.304 -0.3				

Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.7

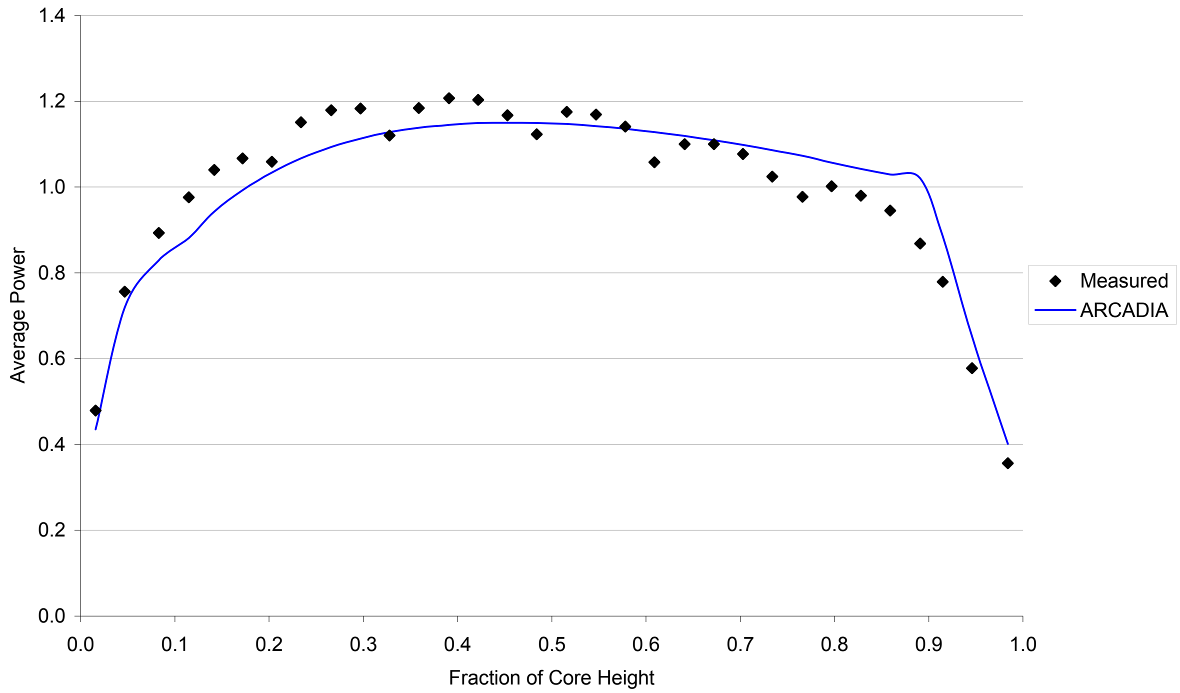
Figure G2 10.4.5-20: Plant G2 EOC 5 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P					0.335 0.339 -0.3	0.482 0.485 -0.3	0.519 0.520 -0.1	0.498 0.498 0.0	0.521 0.520 0.1	0.463 0.461 0.1	0.326 0.325 0.1				
O			0.381 0.386 -0.4	0.700 0.705 -0.5	1.151 1.160 -0.9	1.056 1.061 -0.5	1.328 1.329 -0.1	1.287 1.284 0.3	1.324 1.319 0.6	1.045 1.039 0.5	1.136 1.130 0.6	0.665 0.663 0.2	0.376 0.375 0.1		
N		0.377 0.386 -0.9	1.166 1.175 -0.9	1.392 1.396 -0.4	1.187 1.189 -0.2	1.184 1.186 -0.3	1.161 1.161 0.0	0.974 0.972 0.2	1.160 1.154 0.6	1.176 1.169 0.7	1.164 1.155 0.9	1.377 1.373 0.5	1.162 1.159 0.4	0.382 0.381 0.1	
M		0.666 0.670 -0.4	1.381 1.382 -0.1	1.044 1.040 0.4	1.198 1.194 0.4	1.381 1.378 0.4	1.000 0.999 0.1	1.066 1.061 0.5	0.999 0.993 0.5	1.378 1.366 1.1	1.191 1.175 1.5	1.040 1.032 0.7	1.390 1.384 0.6	0.699 0.697 0.2	
L	0.327 0.329 -0.3	1.137 1.139 -0.2	1.166 1.162 0.4	1.194 1.181 1.4	0.950 0.944 0.7	1.117 1.113 0.4	1.182 1.178 0.5	0.976 0.969 0.6	1.181 1.173 0.7	1.119 1.113 0.6	0.950 0.943 0.7	1.206 1.199 0.7	1.188 1.183 0.5	1.150 1.146 0.4	0.335 0.335 0.0
K	0.464 0.469 -0.5	1.047 1.048 -0.1	1.177 1.173 0.4	1.379 1.369 0.9	1.120 1.115 0.5	0.963 0.961 0.3	1.123 1.120 0.4	1.407 1.399 0.8	1.121 1.116 0.5	0.963 0.959 0.3	1.119 1.116 0.3	1.386 1.382 0.4	1.185 1.182 0.3	1.056 1.053 0.3	0.484 0.484 0.1
J	0.526 0.526 -0.1	1.328 1.324 0.4	1.161 1.153 0.7	0.999 0.995 0.4	1.182 1.179 0.3	1.123 1.122 0.1	0.946 0.945 0.1	1.139 1.135 0.4	0.946 0.943 0.3	1.122 1.119 0.3	1.181 1.181 0.0	1.000 1.004 -0.4	1.160 1.158 0.2	1.330 1.327 0.4	0.529 0.528 0.1
H	0.498 0.498 0.0	1.288 1.283 0.5	0.973 0.966 0.7	1.066 1.064 0.2	0.976 0.977 -0.2	1.408 1.406 0.1	1.139 1.139 0.1	0.876 0.874 0.2	1.142 1.137 0.5	1.407 1.398 0.8	0.975 0.974 0.1	1.065 1.064 0.1	0.973 0.969 0.4	1.287 1.283 0.4	0.499 0.499 0.0
G	0.519 0.520 -0.1	1.328 1.327 0.1	1.161 1.161 0.0	1.000 1.006 -0.6	1.182 1.187 -0.6	1.123 1.126 -0.4	0.947 0.948 -0.2	1.142 1.141 0.2	0.948 0.943 0.5	1.121 1.110 1.1	1.180 1.175 0.5	0.998 0.996 0.1	1.159 1.156 0.3	1.322 1.321 0.1	0.514 0.514 0.0
F	0.482 0.484 -0.2	1.056 1.058 -0.2	1.183 1.187 -0.4	1.381 1.387 -0.5	1.117 1.125 -0.7	0.963 0.970 -0.6	1.122 1.126 -0.4	1.408 1.407 0.0	1.123 1.120 0.3	0.963 0.958 0.5	1.119 1.116 0.3	1.378 1.375 0.3	1.176 1.176 0.0	1.043 1.042 0.1	0.461 0.459 0.2
E	0.335 0.337 -0.2	1.151 1.155 -0.4	1.186 1.192 -0.5	1.198 1.205 -0.7	0.950 0.958 -0.8	1.120 1.131 -1.1	1.181 1.188 -0.7	0.975 0.981 -0.5	1.181 1.183 -0.1	1.118 1.117 0.1	0.950 0.950 0.0	1.192 1.194 -0.2	1.164 1.166 -0.1	1.136 1.137 -0.1	0.326 0.326 0.0
D		0.697 0.701 -0.4	1.391 1.399 -0.7	1.044 1.051 -0.7	1.194 1.203 -0.8	1.379 1.387 -0.8	0.999 1.006 -0.7	1.066 1.072 -0.6	1.000 1.004 -0.5	1.381 1.380 0.1	1.199 1.201 -0.2	1.044 1.048 -0.4	1.379 1.386 -0.7	0.666 0.671 -0.5	
C		0.381 0.384 -0.3	1.163 1.170 -0.7	1.381 1.390 -0.9	1.166 1.173 -0.6	1.177 1.183 -0.7	1.160 1.165 -0.5	0.974 0.978 -0.4	1.161 1.160 0.1	1.183 1.177 0.6	1.187 1.190 -0.3	1.393 1.401 -0.8	1.163 1.175 -1.2	0.376 0.385 -0.9	
B			0.377 0.379 -0.3	0.666 0.671 -0.5	1.137 1.143 -0.6	1.044 1.049 -0.5	1.323 1.328 -0.5	1.288 1.290 -0.2	1.332 1.331 0.1	1.058 1.058 0.0	1.151 1.161 -1.0	0.700 0.707 -0.6	0.383 0.388 -0.5		
A					0.326 0.328 -0.2	0.462 0.464 -0.3	0.515 0.517 -0.2	0.498 0.500 -0.2	0.529 0.531 -0.1	0.485 0.487 -0.3	0.335 0.339 -0.4				

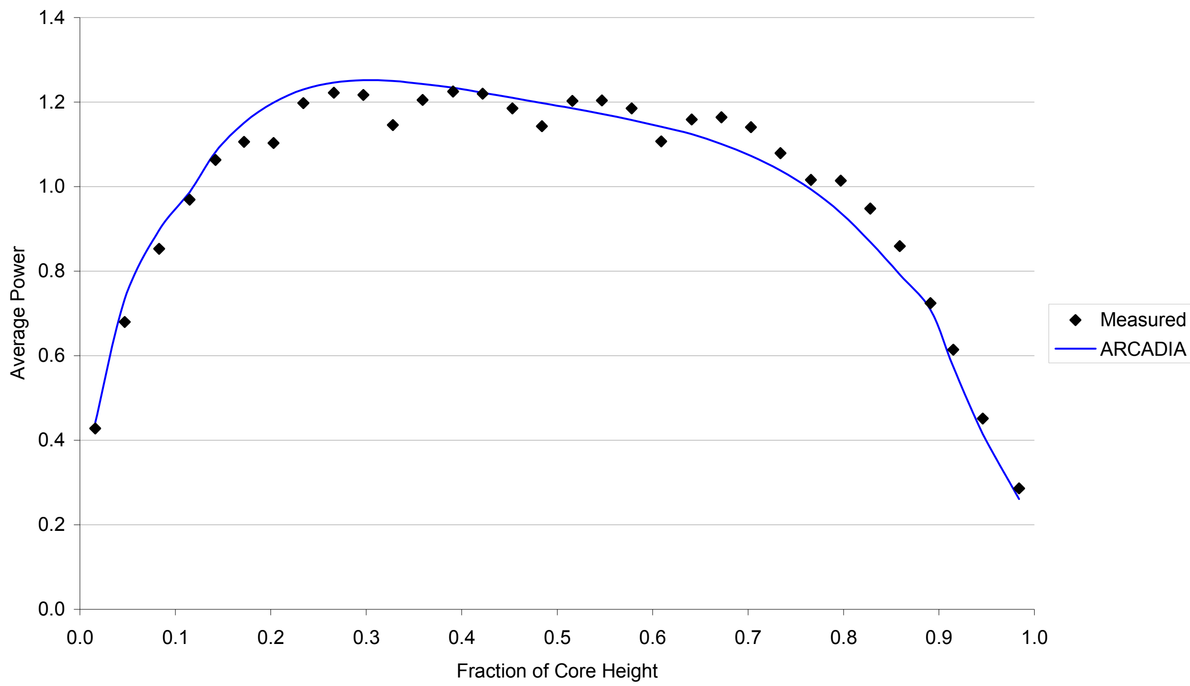
Calculated Minus Measured Average Assembly Powers, RMS Difference * 100 = 0.5

Figure G2 10.4.5-21: Plant G2 BOC 1 Core Average Axial Power Distribution



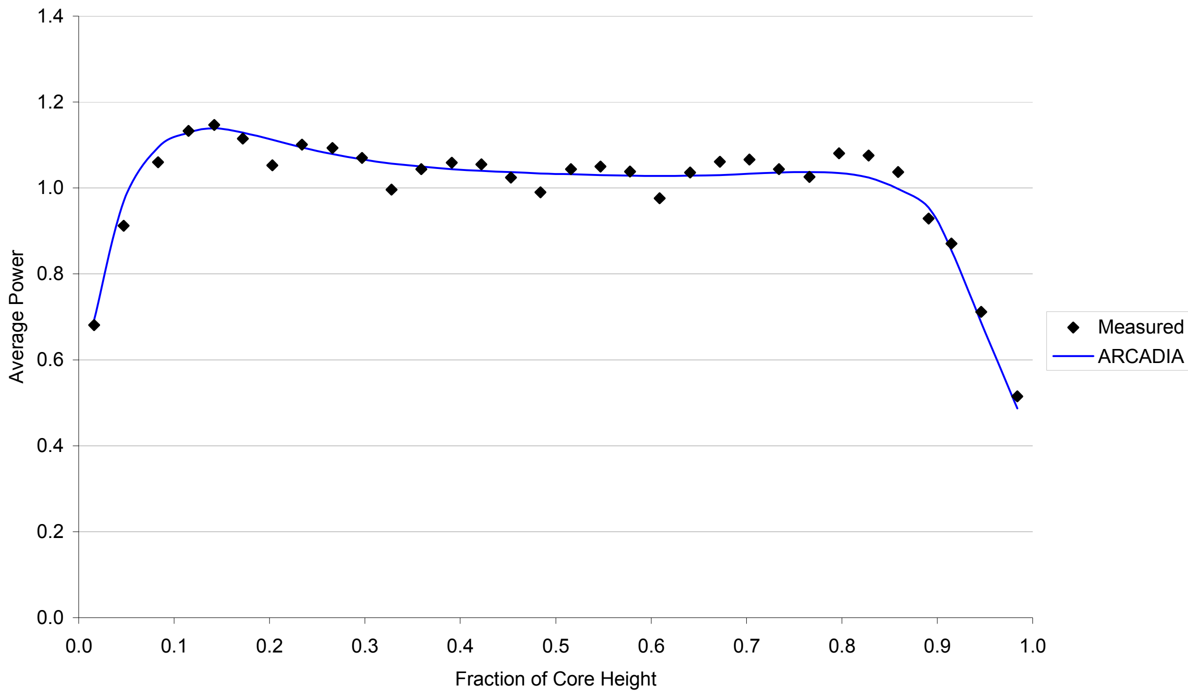
C - M Average Axial Power, RMS Difference *100 = 6.5

Figure G2 10.4.5-22: Plant G2 MOC 1 Core Average Axial Power Distribution



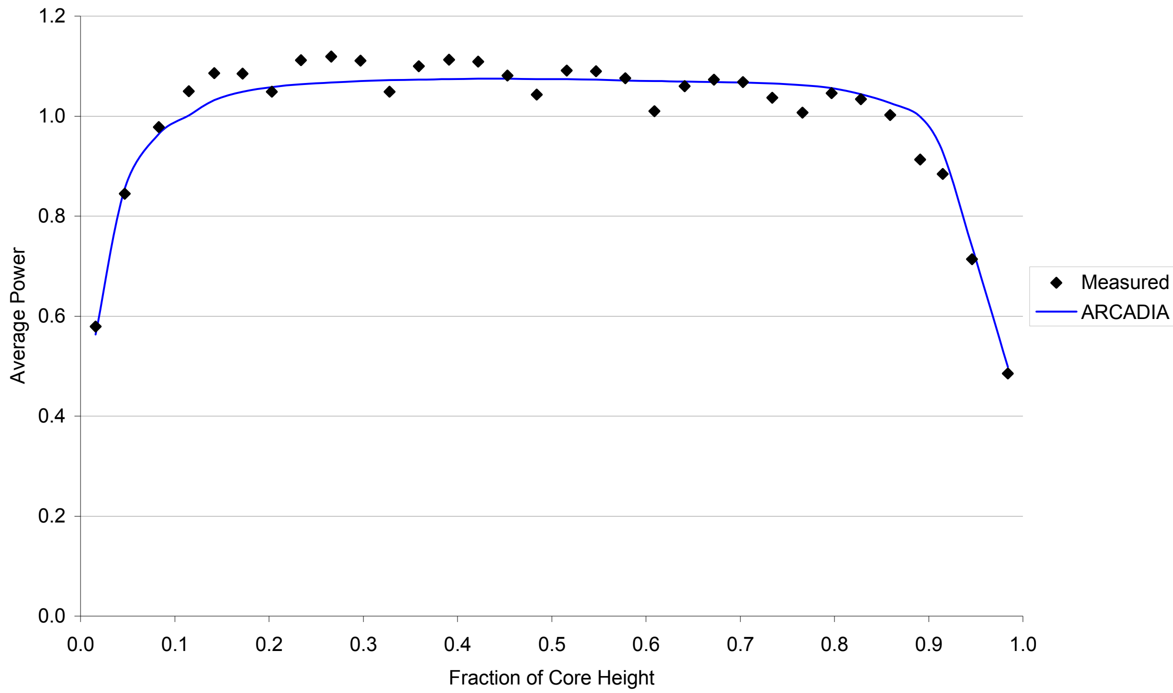
C - M Average Axial Power, RMS Difference *100 = 4.7

Figure G2 10.4.5-23: Plant G2 EOC 1 Core Average Axial Power Distribution



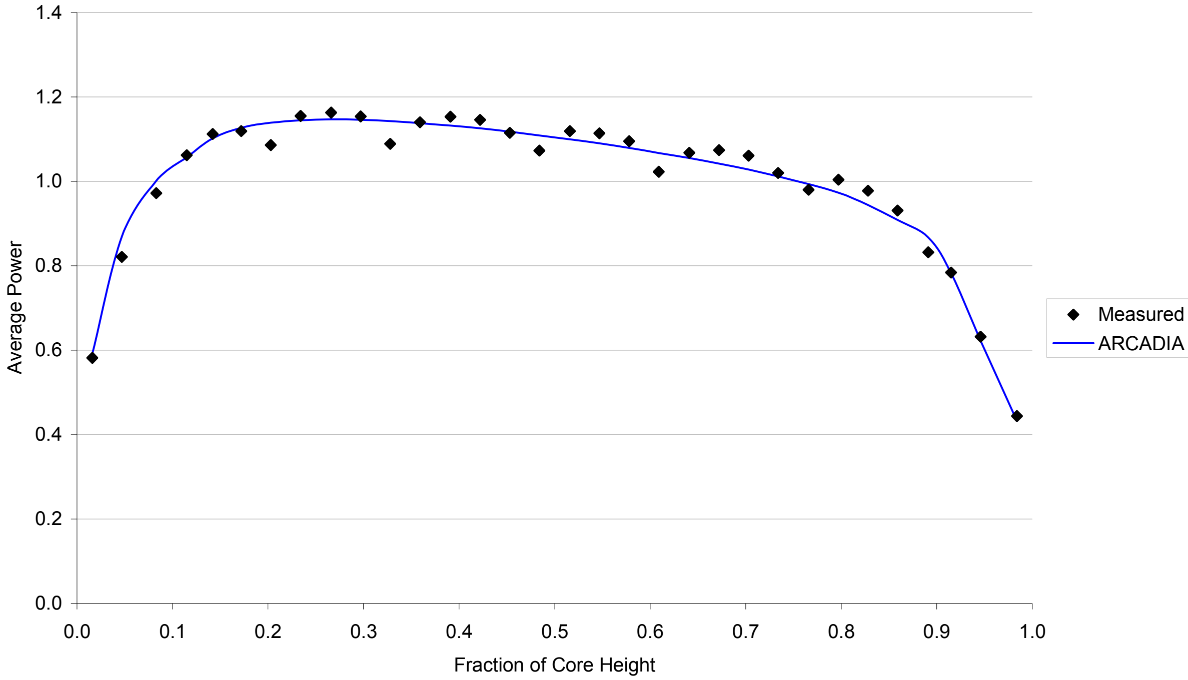
C - M Average Axial Power, RMS Difference *100 = 3.0

Figure G2 10.4.5-24: Plant G2 BOC 2 Core Average Axial Power Distribution



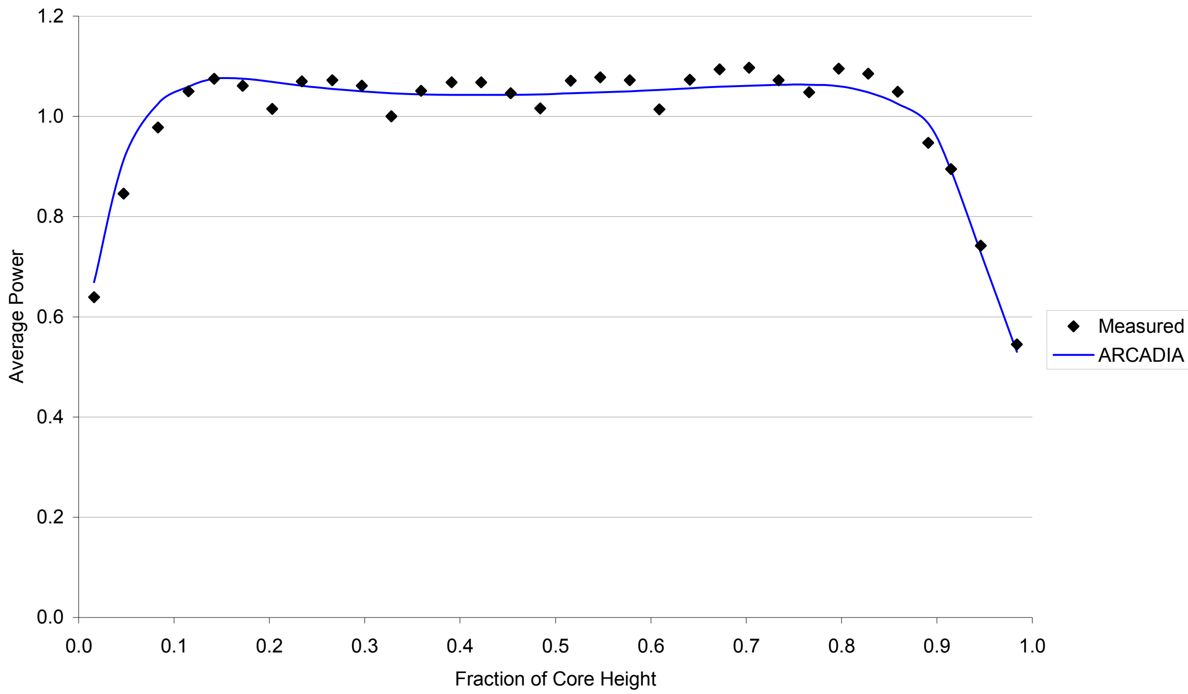
C - M Average Axial Power, RMS Difference *100 = 3.4

Figure G2 10.4.5-25: Plant G2 MOC 2 Core Average Axial Power Distribution



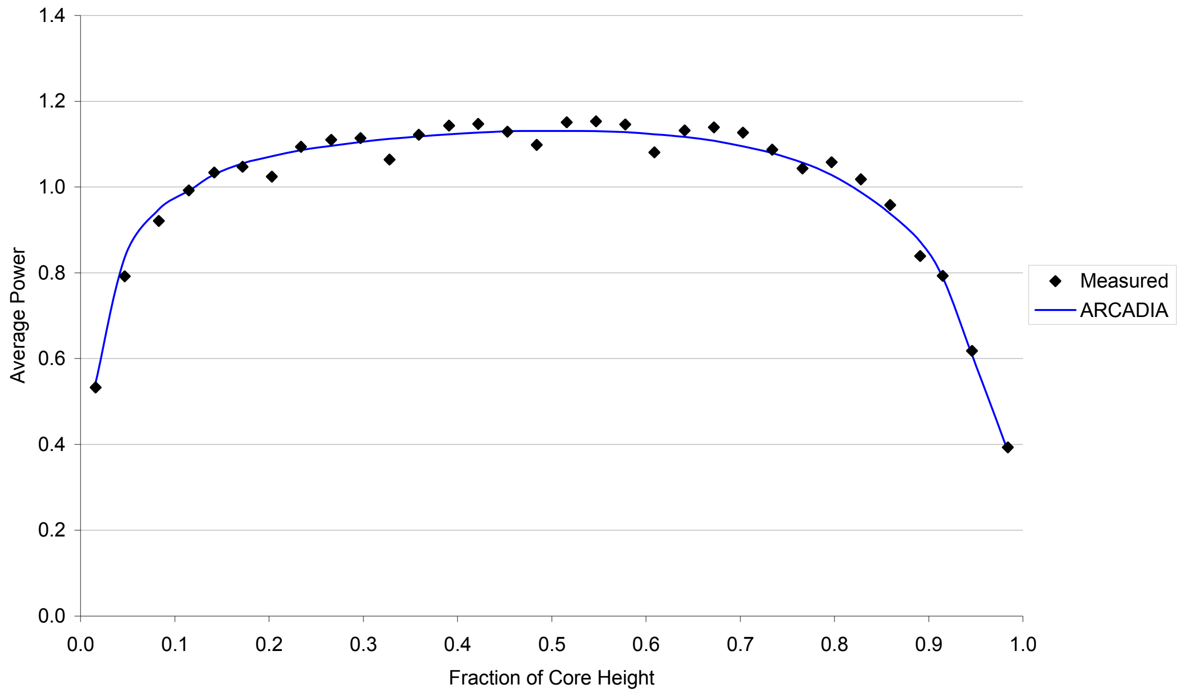
C - M Average Axial Power, RMS Difference *100 = 2.6

Figure G2 10.4.5-26: Plant G2 EOC 2 Core Average Axial Power Distribution



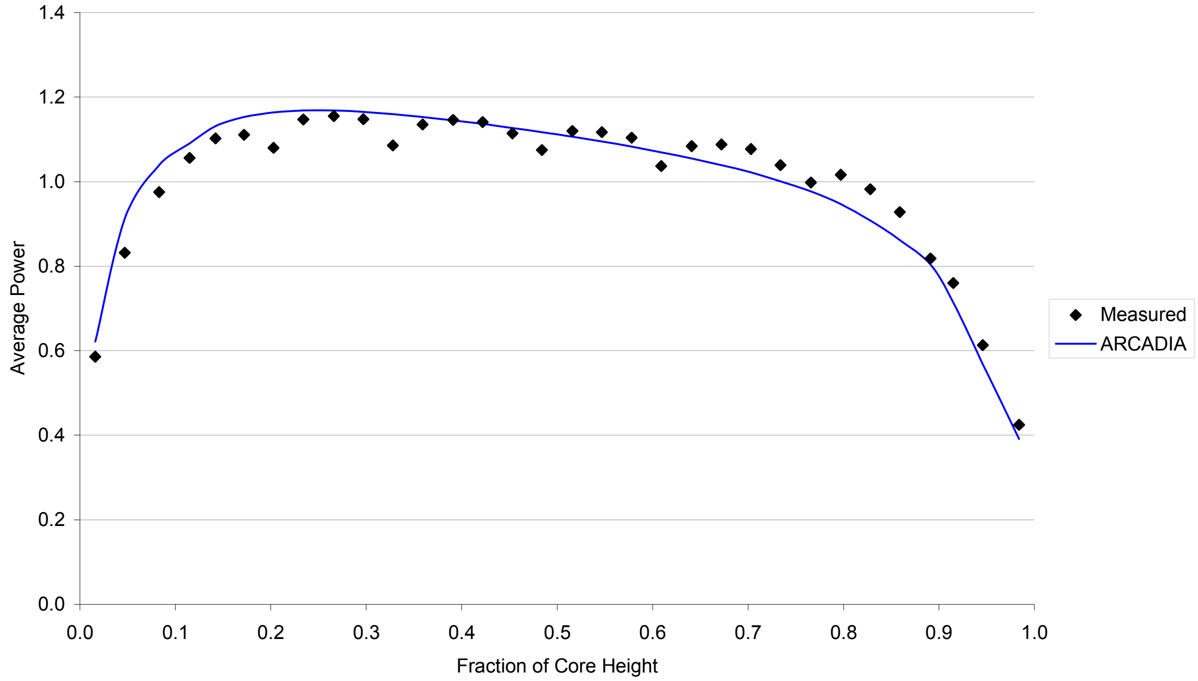
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure G2 10.4.5-27: Plant G2 BOC 3 Core Average Axial Power Distribution



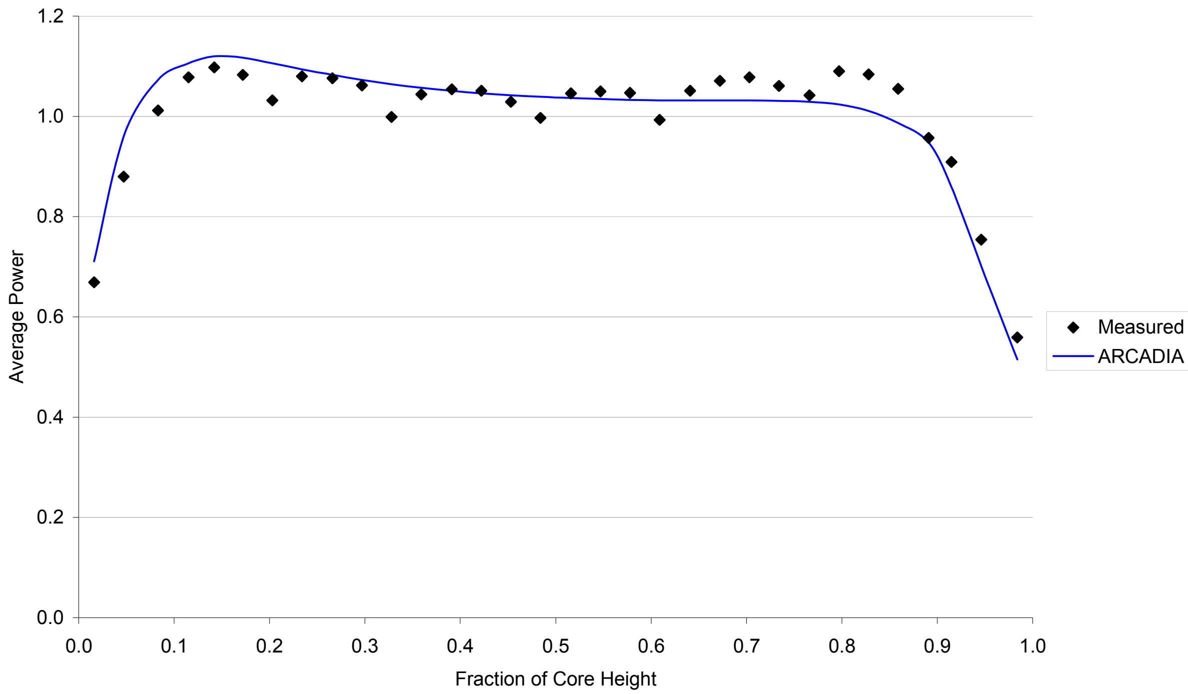
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure G2 10.4.5-28: Plant G2 MOC 3 Core Average Axial Power Distribution



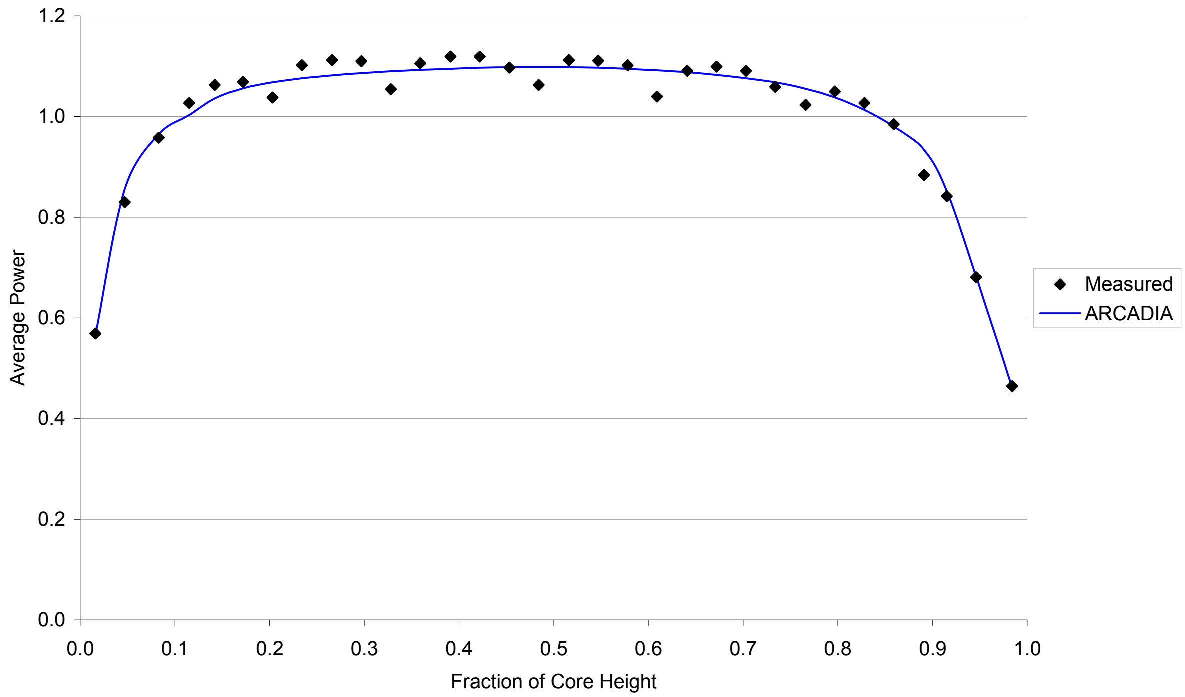
C - M Average Axial Power, RMS Difference *100 = 4.4

Figure G2 10.4.5-29: Plant G2 EOC 3 Core Average Axial Power Distribution



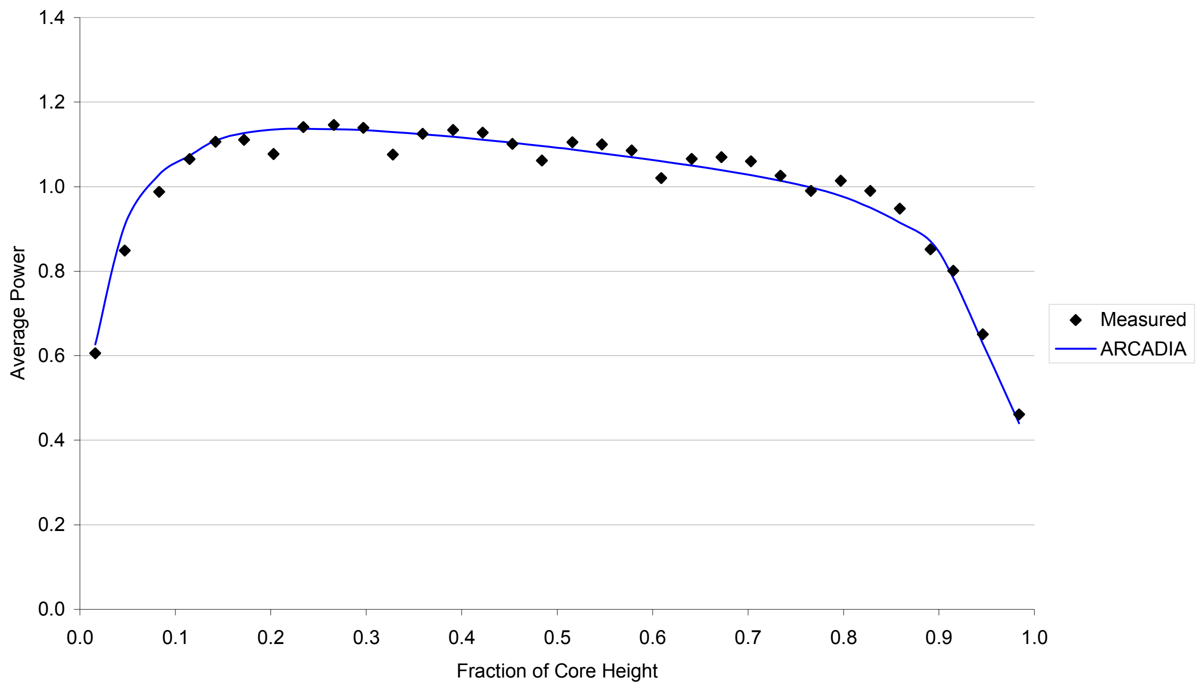
C - M Average Axial Power, RMS Difference *100 = 4.2

Figure G2 10.4.5-30: Plant G2 BOC 4 Core Average Axial Power Distribution



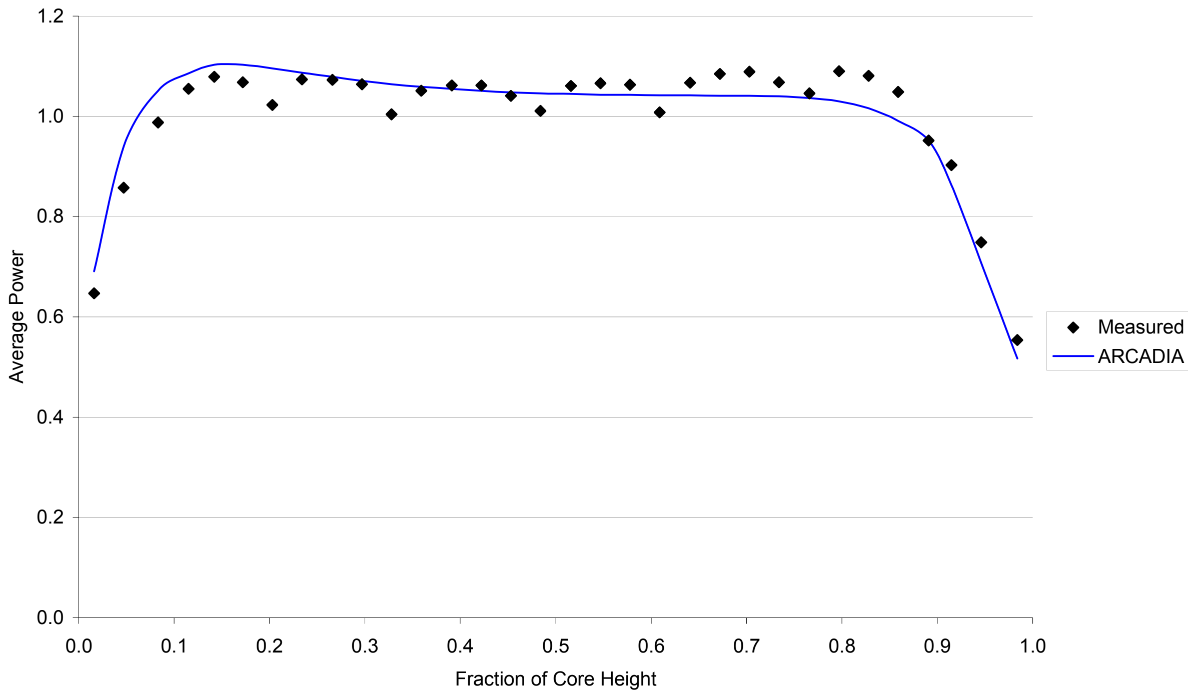
C - M Average Axial Power, RMS Difference *100 = 2.3

Figure G2 10.4.5-31: Plant G2 MOC 4 Core Average Axial Power Distribution



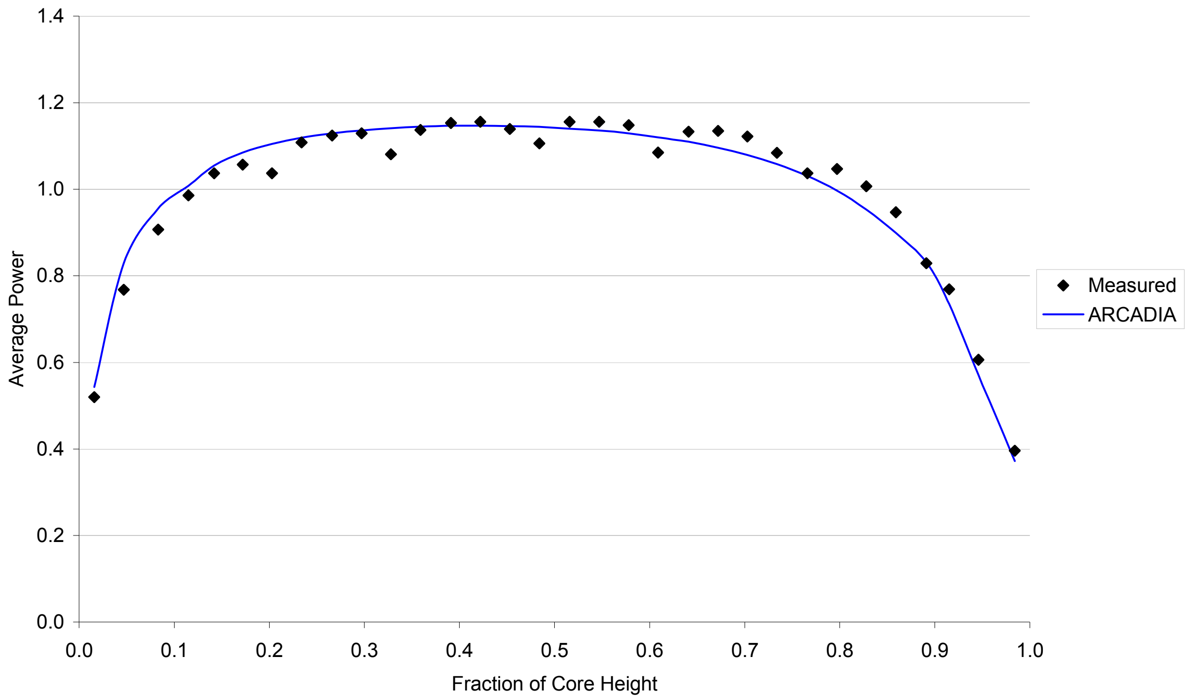
C - M Average Axial Power, RMS Difference *100 = 2.8

Figure G2 10.4.5-32: Plant G2 EOC 4 Core Average Axial Power Distribution



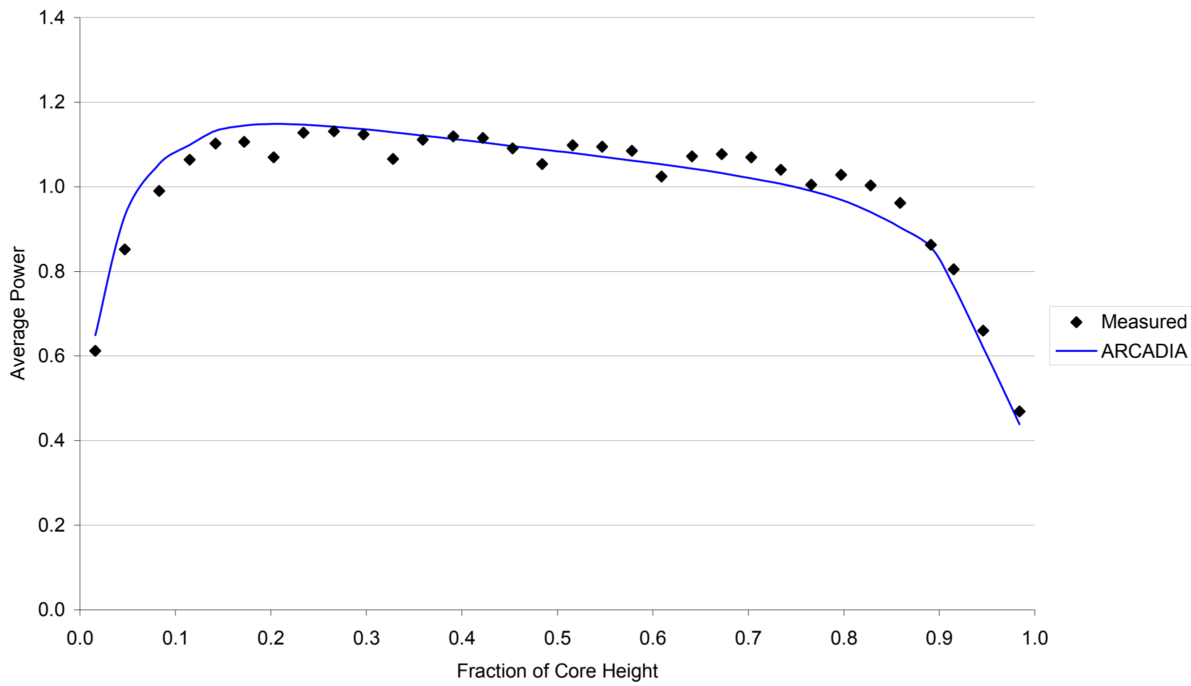
C - M Average Axial Power, RMS Difference *100 = 3.9

Figure G2 10.4.5-33: Plant G2 BOC 5 Core Average Axial Power Distribution



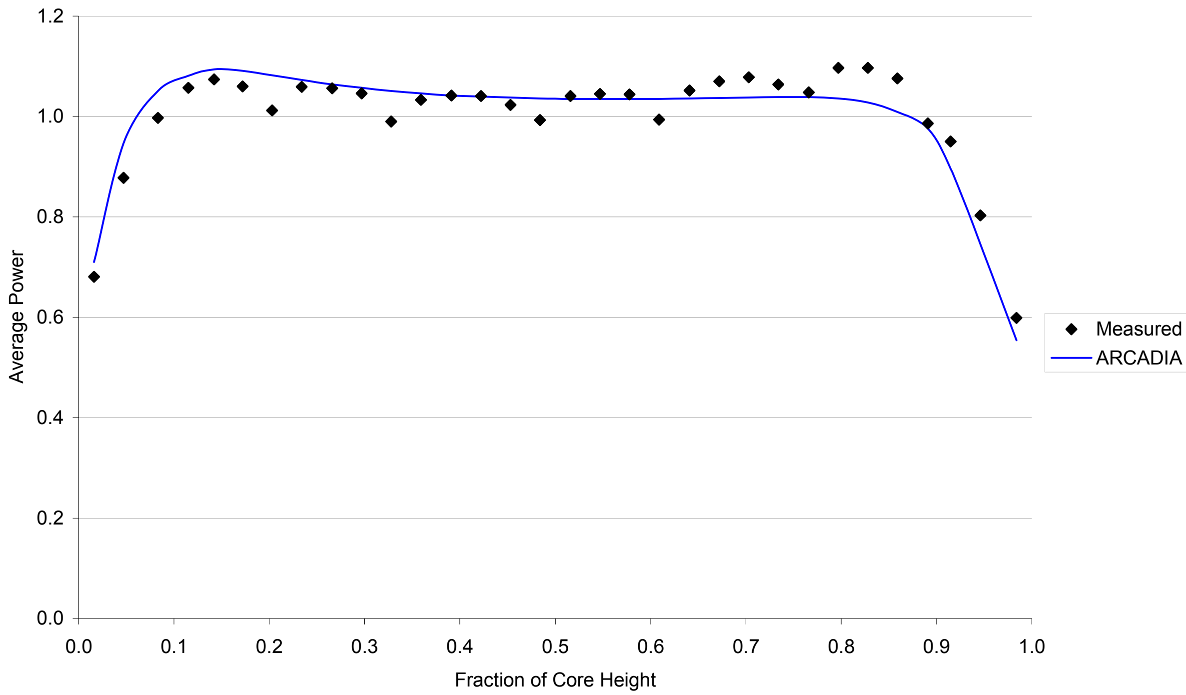
C - M Average Axial Power, RMS Difference *100 = 3.3

Figure G2 10.4.5-34: Plant G2 MOC 5 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 4.0

Figure G2 10.4.5-35: Plant G2 EOC 5 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 3.9

Appendix S1

Table S1 10.3.6-1: Plant S1 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 12-14

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
12	1807	1823	16
13	1846	1830	-16
14	1820	1811	-9

Table S1 10.3.6-2: Plant S1 Cycle 12 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	337	331	-6	-1.7
CB	566	542	-24	-4.2
CC	733	731	-2	-0.3
CD	1282	1261	-21	-1.7
SA	637	605	-32	-5.0
SB	932	901	-31	-3.4
SC	442	414	-28	-6.3
SD	433	410	-23	-5.4
Total	5362	5196	-167	-3.1

Table S1 10.3.6-3: Plant S1 Cycle 13 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	304	311	7	2.2
CB	593	653	60	10.1
CC	738	750	12	1.6
CD	1083	1129	46	4.2
SA	570	608	38	6.7
SB	768	808	40	5.2
SC	397	452	55	13.8
SD	399	450	51	12.8
Total	4852	5161	308	6.4

Table S1 10.3.6-4: Plant S1 Cycle 14 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	429	413	-17	-3.9
CB	448	474	26	5.8
CC	925	921	-4	-0.4
CD	1159	1178	19	1.6
SA	545	534	-11	-2.0
SB	861	872	11	1.3
SC	307	313	6	1.8
SD	319	325	6	1.8
Total	4994	5030	36	0.7

Table S1 10.3.6-5: Plant S1 Summary of Total Bank Worth

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
12	5362	5196	-167	-3.1
13	4852	5161	308	6.4
14	4994	5030	36	0.7

Table S1 10.3.6-6: Plant S1 Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 12-14

Cycle	Measured (pcm/ºF)	Calculated (pcm/ºF)	Difference C - M (pcm/ºF)
12	-3.82	-3.42	0.39
13	-3.46	-2.58	0.88
14	-3.30	-2.92	0.38

Figure S1 10.4.6-1: Plant S1 Cycle 12 Critical Boron Concentration vs. Burnup

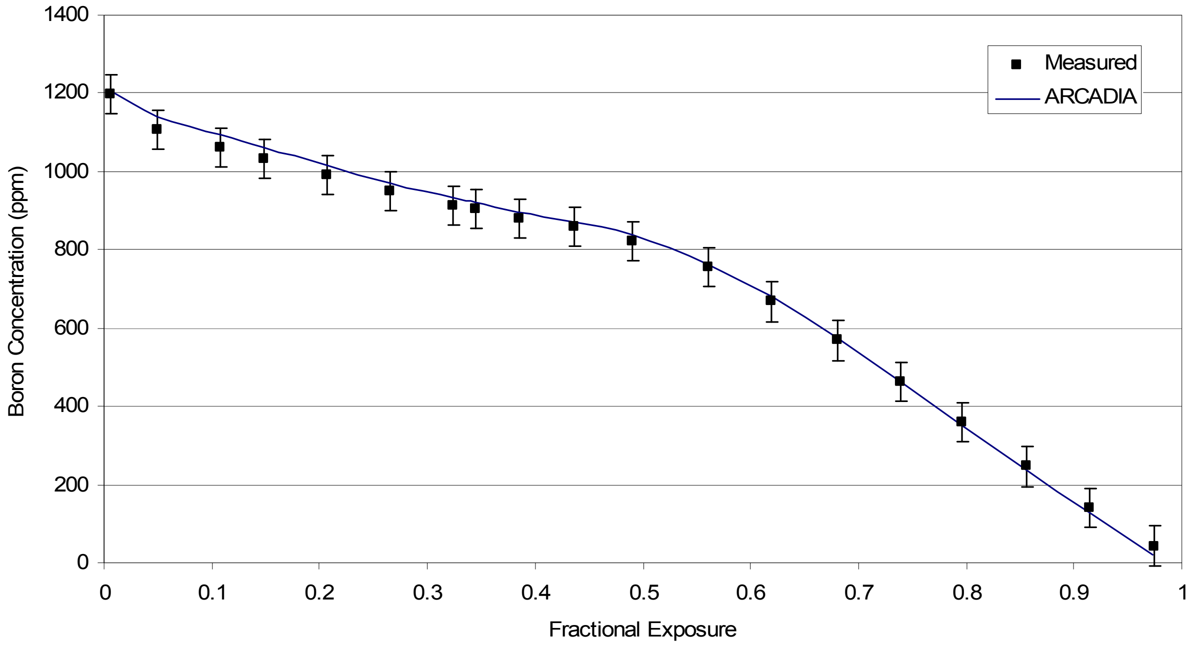


Figure S1 10.4.6-2: Plant S1 Cycle 13 Critical Boron Concentration vs. Burnup

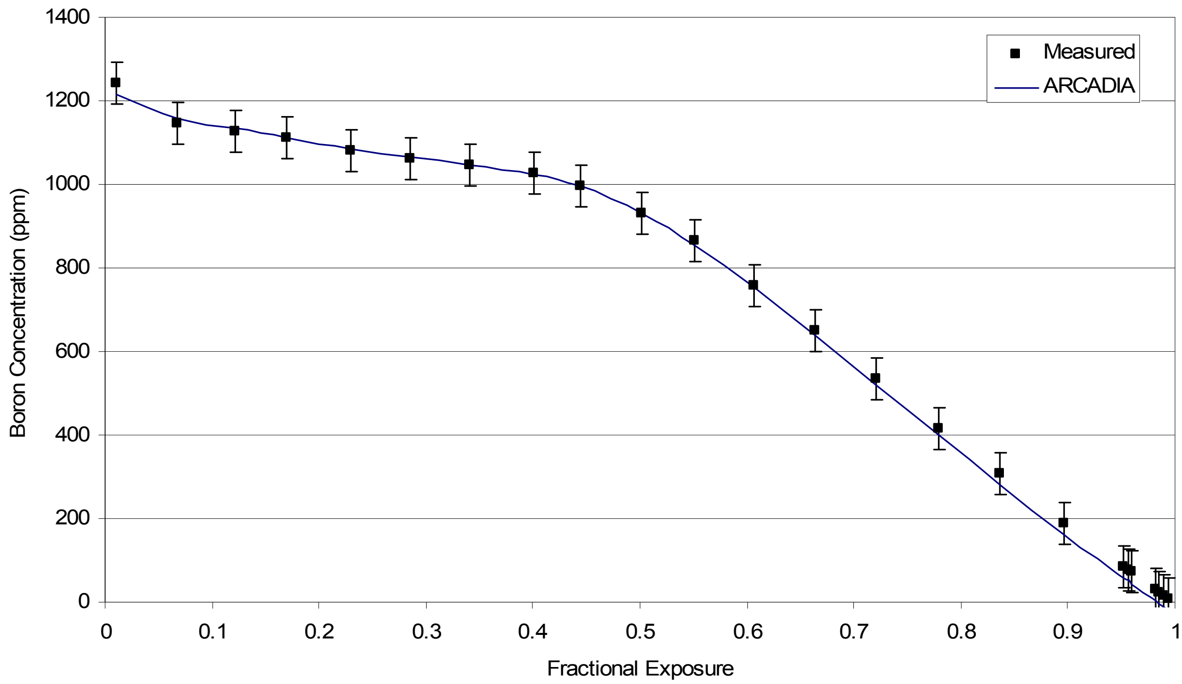


Figure S1 10.4.6-3: Plant S1 Cycle 14 Critical Boron Concentration vs. Burnup

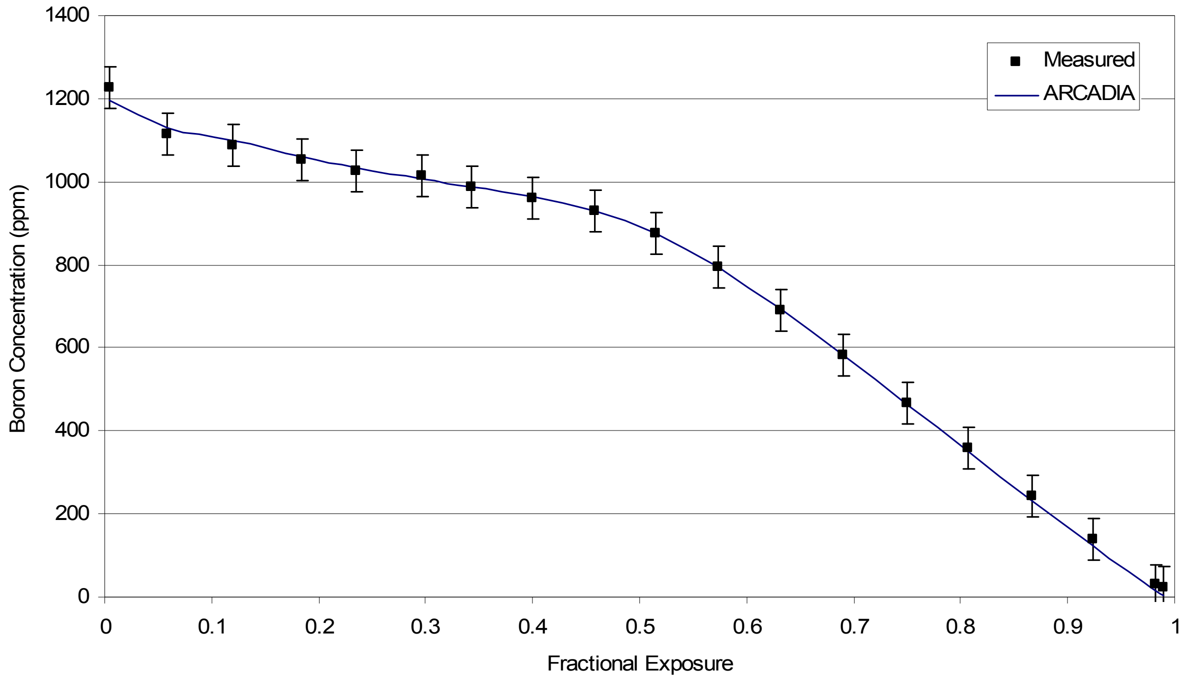


Figure S1 10.4.6-4: Plant S1 BOC 12 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.258 0.258 0.1	0.357 0.354 0.3	0.455 0.449 0.6	0.387 0.381 0.6	0.461 0.456 0.5	0.369 0.371 -0.2	0.271 0.269 0.1				
2			0.331 0.345 -1.4	0.656 0.662 -0.6	0.963 0.962 0.1	1.066 1.055 1.0	1.087 1.073 1.4	1.005 0.984 2.1	1.094 1.079 1.5	1.080 1.069 1.1	0.979 0.970 0.9	0.660 0.654 0.6	0.342 0.340 0.2		
3		0.343 0.349 -0.7	0.996 1.007 -1.1	1.196 1.203 -0.7	1.282 1.283 -0.1	1.175 1.170 0.5	1.254 1.242 1.2	1.167 1.148 1.8	1.248 1.233 1.5	1.186 1.173 1.3	1.291 1.278 1.3	1.206 1.194 1.2	0.995 0.989 0.6	0.330 0.337 -0.7	
4		0.661 0.682 -2.1	1.208 1.215 -0.7	1.279 1.286 -0.8	1.248 1.252 -0.4	1.256 1.255 0.1	1.205 1.199 0.6	1.292 1.282 1.0	1.194 1.186 0.8	1.260 1.251 0.9	1.248 1.238 1.0	1.277 1.265 1.2	1.195 1.185 1.0	0.656 0.653 0.2	
5	0.271 0.278 -0.7	0.981 1.001 -2.0	1.293 1.310 -1.7	1.252 1.266 -1.4	1.237 1.245 -0.9	1.174 1.176 -0.3	1.230 1.226 0.4	1.265 1.258 0.7	1.219 1.219 -0.1	1.171 1.165 0.6	1.233 1.225 0.8	1.246 1.237 0.9	1.281 1.268 1.3	0.962 0.954 0.8	0.258 0.256 0.2
6	0.370 0.382 -1.2	1.082 1.106 -2.4	1.189 1.210 -2.1	1.265 1.288 -2.3	1.178 1.192 -1.4	1.247 1.255 -0.7	1.137 1.132 0.5	1.203 1.187 1.5	1.134 1.126 0.8	1.238 1.230 0.8	1.170 1.164 0.6	1.255 1.249 0.6	1.175 1.168 0.6	1.065 1.056 0.9	0.357 0.355 0.2
7	0.462 0.477 -1.5	1.097 1.124 -2.8	1.251 1.282 -3.1	1.199 1.238 -3.9	1.228 1.248 -2.0	1.180 1.187 -0.7	1.139 1.132 0.7	0.946 0.938 0.9	1.132 1.122 1.0	1.133 1.124 1.0	1.230 1.224 0.6	1.205 1.203 0.2	1.255 1.255 -0.1	1.088 1.082 0.5	0.455 0.453 0.2
8	0.388 0.407 -1.9	1.007 1.035 -2.8	1.170 1.198 -2.8	1.297 1.325 -2.9	1.273 1.291 -1.8	1.212 1.221 -0.9	0.951 0.949 0.3	0.955 0.947 0.8	0.949 0.939 1.0	1.209 1.196 1.3	1.271 1.264 0.6	1.295 1.297 -0.2	1.169 1.171 -0.3	1.006 0.999 0.7	0.387 0.387 0.1
9	0.456 0.470 -1.4	1.089 1.117 -2.8	1.256 1.284 -2.7	1.208 1.232 -2.4	1.235 1.254 -2.0	1.141 1.150 -0.9	1.142 1.142 0.0	0.952 0.945 0.7	1.141 1.125 1.6	1.180 1.168 1.1	1.228 1.220 0.8	1.198 1.194 0.4	1.251 1.249 0.2	1.096 1.094 0.2	0.462 0.466 -0.4
10	0.357 0.366 -0.8	1.067 1.088 -2.1	1.177 1.199 -2.2	1.258 1.281 -2.3	1.176 1.202 -2.6	1.250 1.260 -1.1	1.181 1.181 0.0	1.213 1.204 0.9	1.141 1.130 1.1	1.249 1.238 1.1	1.179 1.170 0.9	1.265 1.257 0.9	1.189 1.185 0.4	1.082 1.082 0.0	0.370 0.373 -0.4
11	0.258 0.263 -0.5	0.964 0.979 -1.5	1.283 1.300 -1.7	1.249 1.265 -1.6	1.238 1.251 -1.3	1.179 1.184 -0.5	1.229 1.224 0.5	1.273 1.257 1.6	1.234 1.225 0.9	1.176 1.167 0.9	1.238 1.228 1.0	1.252 1.242 1.0	1.293 1.288 0.6	0.981 0.983 -0.2	0.271 0.284 -1.3
12		0.657 0.664 -0.8	1.197 1.207 -1.0	1.280 1.289 -0.9	1.253 1.260 -0.7	1.266 1.267 -0.1	1.199 1.191 0.9	1.297 1.281 1.6	1.208 1.209 -0.1	1.258 1.249 0.9	1.249 1.236 1.3	1.279 1.260 1.9	1.208 1.201 0.8	0.662 0.663 -0.2	
13		0.331 0.333 -0.2	0.997 1.000 -0.3	1.209 1.215 -0.6	1.294 1.297 -0.4	1.190 1.186 0.3	1.252 1.235 1.6	1.170 1.135 3.5	1.256 1.238 1.8	1.177 1.163 1.4	1.283 1.268 1.5	1.197 1.184 1.3	0.997 0.993 0.4	0.343 0.354 -1.2	
14			0.343 0.353 -1.1	0.662 0.668 -0.6	0.981 0.987 -0.6	1.083 1.079 0.3	1.097 1.083 1.4	1.007 0.988 1.9	1.089 1.071 1.8	1.067 1.050 1.7	0.964 0.951 1.2	0.657 0.650 0.7	0.331 0.329 0.2		
15					0.271 0.285 -1.4	0.370 0.371 -0.2	0.462 0.457 0.5	0.388 0.381 0.6	0.456 0.449 0.7	0.358 0.352 0.5	0.258 0.255 0.3				

C -M Average Assembly Power, RMS Difference *100 = 1.2

Figure S1 10.4.6-5: Plant S1 MOC 12 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.291 0.292 -0.1	0.398 0.398 0.0	0.502 0.498 0.4	0.437 0.430 0.7	0.508 0.506 0.2	0.411 0.421 -1.0	0.304 0.306 -0.2				
2			0.353 0.367 -1.4	0.684 0.693 -1.0	1.051 1.060 -0.8	1.159 1.166 -0.7	1.177 1.168 0.9	1.133 1.106 2.7	1.184 1.174 1.1	1.174 1.174 0.0	1.068 1.067 0.1	0.685 0.684 0.1	0.363 0.363 0.0		
3		0.363 0.373 -1.0	1.029 1.050 -2.1	1.293 1.310 -1.6	1.338 1.346 -0.8	1.081 1.081 0.0	1.102 1.094 0.7	1.039 1.028 1.1	1.100 1.091 0.8	1.090 1.090 -0.1	1.348 1.344 0.4	1.305 1.302 0.3	1.029 1.031 -0.2	0.353 0.363 -1.0	
4		0.685 0.710 -2.5	1.305 1.331 -2.7	1.180 1.194 -1.4	1.158 1.161 -0.3	1.277 1.273 0.4	1.032 1.023 0.9	1.263 1.247 1.5	1.028 1.017 1.1	1.284 1.273 1.1	1.161 1.150 1.1	1.181 1.175 0.6	1.294 1.293 0.1	0.684 0.686 -0.2	
5	0.304 0.315 -1.1	1.068 1.099 -3.0	1.348 1.375 -2.7	1.161 1.173 -1.1	1.375 1.370 0.5	1.089 1.081 0.8	1.063 1.050 1.2	1.098 1.081 1.7	1.058 1.043 1.5	1.090 1.075 1.6	1.374 1.344 3.0	1.158 1.148 1.0	1.338 1.336 0.2	1.051 1.336 -0.1	0.291 0.291 0.0
6	0.410 0.435 -2.4	1.174 1.211 -3.6	1.090 1.113 -2.4	1.285 1.301 -1.6	1.092 1.091 0.1	1.342 1.327 1.5	1.094 1.078 1.6	1.343 1.314 2.9	1.095 1.077 1.8	1.339 1.323 1.6	1.088 1.075 1.4	1.276 1.268 0.8	1.080 1.079 0.1	1.159 1.161 -0.2	0.398 0.398 0.0
7	0.508 0.530 -2.2	1.184 1.222 -3.7	1.099 1.125 -2.6	1.028 1.046 -1.8	1.060 1.062 -0.1	1.127 1.117 1.0	1.342 1.323 1.9	0.998 0.980 1.8	1.338 1.317 2.1	1.093 1.086 0.7	1.063 1.054 0.9	1.032 1.029 0.3	1.102 1.106 -0.4	1.177 1.181 -0.4	0.502 0.503 -0.2
8	0.437 0.464 -2.7	1.133 1.171 -3.8	1.039 1.062 -2.3	1.263 1.278 -1.5	1.100 1.097 0.2	1.347 1.336 1.1	1.000 0.985 1.5	0.979 0.960 1.9	0.999 0.975 2.3	1.346 1.317 2.9	1.100 1.088 1.2	1.263 1.264 0.0	1.039 1.040 -0.1	1.133 1.138 -0.5	0.437 0.440 -0.3
9	0.502 0.521 -1.9	1.177 1.219 -4.2	1.101 1.125 -2.4	1.032 1.044 -1.2	1.063 1.066 -0.3	1.095 1.088 0.7	1.343 1.323 2.0	1.000 0.978 2.2	1.343 1.294 4.8	1.127 1.101 2.5	1.060 1.047 1.3	1.028 1.026 0.2	1.100 1.103 -0.3	1.185 1.193 -0.8	0.508 0.515 -0.8
10	0.397 0.408 -1.0	1.159 1.186 -2.7	1.080 1.097 -1.7	1.277 1.290 -1.3	1.089 1.097 -0.8	1.342 1.336 0.6	1.127 1.110 1.7	1.347 1.324 2.3	1.095 1.072 2.3	1.342 1.318 2.4	1.092 1.077 1.5	1.285 1.285 0.1	1.090 1.095 -0.5	1.174 1.186 -1.2	0.410 0.418 -0.8
11	0.291 0.296 -0.5	1.051 1.066 -1.5	1.338 1.350 -1.3	1.158 1.165 -0.7	1.374 1.379 -0.4	1.092 1.088 0.3	1.060 1.051 1.0	1.100 1.087 1.2	1.063 1.051 1.2	1.089 1.073 1.6	1.375 1.345 3.0	1.161 1.158 0.3	1.348 1.358 -0.9	1.068 1.084 -1.6	0.304 0.324 -1.9
12		0.683 0.688 -0.5	1.293 1.298 -0.5	1.180 1.184 -0.3	1.161 1.162 -0.1	1.285 1.282 0.3	1.028 1.021 0.7	1.263 1.252 1.0	1.032 1.035 -0.3	1.277 1.269 0.7	1.158 1.151 0.7	1.180 1.189 -0.9	1.304 1.318 -1.4	0.685 0.697 -1.2	
13		0.353 0.353 0.0	1.029 1.022 0.6	1.304 1.305 -0.1	1.348 1.350 -0.2	1.090 1.087 0.3	1.099 1.090 0.9	1.039 1.020 1.9	1.101 1.094 0.7	1.080 1.075 0.5	1.338 1.336 0.2	1.293 1.300 -0.7	1.029 1.042 -1.3	0.363 0.382 -1.9	
14			0.363 0.372 -0.9	0.685 0.689 -0.4	1.068 1.075 -0.7	1.174 1.174 0.0	1.184 1.177 0.8	1.133 1.123 0.9	1.177 1.170 0.7	1.159 1.154 0.5	1.051 1.050 0.2	0.683 0.685 -0.2	0.353 0.356 -0.3		
15					0.304 0.319 -1.5	0.410 0.413 -0.3	0.508 0.507 0.1	0.437 0.439 -0.2	0.502 0.500 0.2	0.398 0.396 0.2	0.291 0.290 0.1				

C -M Average Assembly Power, RMS Difference *100 = 1.4

Figure S1 10.4.6-6: Plant S1 EOC 12 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.348 0.349 -0.1	0.470 0.469 0.1	0.588 0.588 0.0	0.522 0.525 -0.3	0.592 0.611 -1.9	0.482 0.532 -5.0	0.361 0.377 -1.7				
2			0.394 0.434 -4.0	0.721 0.737 -1.7	1.102 1.108 -0.6	1.220 1.213 0.7	1.243 1.240 0.3	1.211 1.207 0.4	1.244 1.261 -1.7	1.223 1.255 -3.2	1.109 1.131 -2.2	0.719 0.728 -0.9	0.403 0.406 -0.3		
3		0.402 0.411 -0.8	1.026 1.052 -2.6	1.238 1.256 -1.8	1.317 1.324 -0.7	1.087 1.086 0.0	1.105 1.106 -0.1	1.043 1.051 -0.8	1.101 1.111 -1.1	1.089 1.103 -1.4	1.318 1.333 -1.4	1.244 1.252 -0.8	1.027 1.032 -0.5	0.394 0.403 -0.9	
4		0.719 0.728 -0.9	1.243 1.260 -1.7	1.112 1.121 -1.0	1.112 1.114 -0.2	1.304 1.302 0.3	1.021 1.019 0.2	1.212 1.212 0.0	1.017 1.020 -0.4	1.306 1.314 -0.7	1.113 1.118 -0.5	1.113 1.113 -0.1	1.239 1.233 0.6	0.721 0.718 0.3	
5	0.360 0.375 -1.5	1.108 1.125 -1.7	1.317 1.329 -1.1	1.112 1.115 -0.4	1.286 1.283 0.3	1.045 1.037 0.8	1.024 1.017 0.7	1.048 1.043 0.5	1.021 1.019 0.1	1.047 1.048 -0.1	1.288 1.289 -0.1	1.112 1.107 0.6	1.318 1.296 2.1	1.103 1.087 1.5	0.348 0.344 0.5
6	0.481 0.527 -4.5	1.222 1.244 -2.2	1.088 1.090 -0.3	1.305 1.303 0.2	1.046 1.037 0.9	1.244 1.217 2.7	1.035 1.022 1.3	1.272 1.257 1.5	1.037 1.031 0.6	1.246 1.243 0.2	1.046 1.043 0.3	1.305 1.297 0.8	1.087 1.075 1.2	1.220 1.200 2.1	0.470 0.464 0.7
7	0.592 0.605 -1.4	1.243 1.248 -0.5	1.099 1.098 0.2	1.015 1.011 0.5	1.019 1.010 0.9	1.060 1.047 1.3	1.276 1.265 1.1	0.966 0.959 0.8	1.277 1.269 0.8	1.035 1.035 0.0	1.024 1.019 0.5	1.021 1.014 0.6	1.105 1.102 0.3	1.243 1.232 1.1	0.588 0.582 0.6
8	0.522 0.523 -0.1	1.210 1.195 1.5	1.042 1.031 1.1	1.211 1.199 1.1	1.046 1.036 1.0	1.269 1.260 0.9	0.966 0.965 0.1	0.954 0.948 0.6	0.966 0.957 1.0	1.270 1.253 1.7	1.047 1.037 1.0	1.212 1.199 1.3	1.042 1.038 0.5	1.210 1.204 0.6	0.522 0.518 0.4
9	0.588 0.574 1.4	1.242 1.198 4.4	1.105 1.083 2.2	1.020 1.008 1.2	1.023 1.015 0.8	1.033 1.027 0.6	1.274 1.269 0.5	0.965 0.959 0.7	1.275 1.257 1.8	1.060 1.047 1.2	1.019 1.009 1.1	1.016 1.006 0.9	1.100 1.097 0.3	1.243 1.242 0.1	0.592 0.585 0.7
10	0.470 0.459 1.1	1.220 1.189 3.1	1.086 1.067 2.0	1.304 1.288 1.5	1.045 1.041 0.3	1.243 1.236 0.6	1.059 1.057 0.2	1.269 1.264 0.5	1.033 1.028 0.6	1.243 1.233 1.0	1.045 1.033 1.2	1.305 1.288 1.7	1.088 1.091 -0.3	1.222 1.236 -1.4	0.481 0.494 -1.2
11	0.348 0.341 0.7	1.102 1.079 2.3	1.317 1.294 2.2	1.111 1.098 1.3	1.286 1.275 1.1	1.045 1.037 0.8	1.019 1.015 0.4	1.046 1.047 0.0	1.023 1.028 -0.5	1.045 1.042 0.3	1.286 1.264 2.2	1.112 1.116 -0.5	1.317 1.336 -1.9	1.108 1.138 -3.0	0.360 0.408 -4.7
12		0.720 0.707 1.3	1.238 1.217 2.1	1.111 1.098 1.3	1.111 1.100 1.1	1.305 1.286 1.8	1.015 1.010 0.5	1.211 1.216 -0.6	1.020 1.049 -2.9	1.304 1.317 -1.3	1.111 1.122 -1.0	1.112 1.148 -3.7	1.243 1.272 -2.9	0.718 0.738 -1.9	
13		0.394 0.386 0.7	1.026 1.006 2.1	1.243 1.232 1.1	1.317 1.309 0.8	1.087 1.079 0.8	1.099 1.092 0.7	1.042 1.037 0.5	1.105 1.113 -0.9	1.086 1.094 -0.8	1.317 1.331 -1.5	1.238 1.263 -2.5	1.026 1.050 -2.4	0.402 0.415 -1.3	
14			0.402 0.438 -3.6	0.718 0.726 -0.7	1.108 1.109 -0.2	1.222 1.217 0.5	1.243 1.231 1.1	1.210 1.209 0.1	1.242 1.245 -0.3	1.220 1.218 0.2	1.102 1.110 -0.8	0.720 0.732 -1.1	0.394 0.402 -0.8		
15					0.360 0.372 -1.2	0.481 0.483 -0.2	0.592 0.592 0.0	0.521 0.531 -0.9	0.588 0.591 -0.3	0.470 0.471 -0.1	0.348 0.350 -0.2				

Calculated Power
Measured Power
Difference (C-M)*100

C -M Average Assembly Power, RMS Difference *100 = 1.4

Figure S1 10.4.6-7: Plant S1 BOC 13 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.281 0.279 0.2	0.386 0.384 0.3	0.411 0.415 -0.4	0.437 0.432 0.5	0.413 0.407 0.6	0.393 0.386 0.6	0.283 0.279 0.5				
2			0.327 0.326 0.1	0.676 0.673 0.3	0.988 0.980 0.8	1.177 1.160 1.6	1.007 0.994 1.2	1.154 1.132 2.2	1.016 0.998 1.8	1.184 1.162 2.2	0.992 0.974 1.8	0.679 0.666 1.3	0.333 0.327 0.5	Calculated Power Measured Power Difference (C-M)*100	
3		0.332 0.332 0.0	1.037 1.034 0.4	1.241 1.237 0.4	1.333 1.328 0.6	1.243 1.234 0.8	1.251 1.236 1.5	1.220 1.185 3.5	1.263 1.240 2.3	1.242 1.218 2.4	1.335 1.312 2.3	1.243 1.215 2.8	1.037 1.022 1.6	0.327 0.327 0.0	
4		0.679 0.681 -0.2	1.243 1.238 0.5	1.163 1.163 0.0	1.203 1.205 -0.2	1.263 1.267 -0.4	1.145 1.145 0.0	1.244 1.237 0.7	1.141 1.135 0.6	1.262 1.252 1.0	1.205 1.195 0.9	1.163 1.149 1.4	1.241 1.227 1.4	0.676 0.670 0.5	
5	0.283 0.286 -0.3	0.992 0.998 -0.6	1.335 1.342 -0.6	1.205 1.213 -0.8	1.249 1.256 -0.7	1.119 1.142 -2.3	1.117 1.133 -1.6	1.160 1.171 -1.1	1.120 1.132 -1.3	1.117 1.119 -0.2	1.248 1.256 -0.7	1.203 1.198 0.5	1.333 1.322 1.1	0.988 0.980 0.8	0.280 0.279 0.2
6	0.393 0.397 -0.5	1.184 1.196 -1.2	1.242 1.257 -1.5	1.263 1.283 -2.0	1.118 1.147 -2.9	1.267 1.337 -6.9	1.160 1.192 -3.2	1.260 1.281 -2.1	1.164 1.172 -0.8	1.267 1.262 0.5	1.119 1.119 0.0	1.263 1.260 0.3	1.242 1.236 0.6	1.177 1.167 1.0	0.386 0.384 0.2
7	0.413 0.420 -0.7	1.016 1.030 -1.4	1.263 1.282 -1.9	1.142 1.167 -2.5	1.120 1.149 -2.9	1.164 1.202 -3.8	1.204 1.229 -2.5	0.915 0.930 -1.4	1.204 1.207 -0.3	1.160 1.133 2.7	1.117 1.115 0.3	1.145 1.146 -0.1	1.251 1.249 0.2	1.007 1.003 0.3	0.411 0.410 0.1
8	0.437 0.446 -1.0	1.154 1.169 -1.5	1.220 1.237 -1.8	1.244 1.266 -2.2	1.160 1.185 -2.5	1.260 1.294 -3.4	0.915 0.947 -3.2	0.917 0.937 -2.0	0.915 0.930 -1.5	1.260 1.284 -2.4	1.160 1.175 -1.5	1.244 1.255 -1.1	1.220 1.216 0.4	1.154 1.154 0.0	0.437 0.436 0.1
9	0.411 0.417 -0.6	1.007 1.015 -0.8	1.251 1.266 -1.4	1.145 1.162 -1.7	1.117 1.139 -2.1	1.160 1.186 -2.5	1.204 1.233 -2.9	0.915 0.935 -1.9	1.204 1.230 -2.6	1.164 1.187 -2.3	1.120 1.147 -2.7	1.141 1.157 -1.6	1.263 1.269 -0.6	1.016 1.018 -0.1	0.413 0.409 0.5
10	0.386 0.393 -0.7	1.177 1.188 -1.1	1.243 1.253 -1.1	1.263 1.276 -1.3	1.119 1.139 -1.9	1.267 1.288 -2.1	1.164 1.189 -2.5	1.260 1.280 -2.0	1.161 1.177 -1.6	1.267 1.285 -1.8	1.117 1.137 -2.0	1.262 1.286 -2.4	1.242 1.250 -0.8	1.184 1.186 -0.2	0.393 0.393 0.0
11	0.281 0.295 -1.5	0.988 0.997 -0.9	1.333 1.338 -0.4	1.203 1.207 -0.4	1.249 1.252 -0.3	1.117 1.122 -0.5	1.120 1.125 -0.5	1.160 1.169 -0.9	1.117 1.121 -0.3	1.119 1.125 -0.6	1.248 1.265 -1.6	1.205 1.210 -0.6	1.335 1.336 -0.1	0.992 0.993 -0.1	0.283 0.284 -0.1
12		0.676 0.676 0.0	1.241 1.235 0.6	1.163 1.156 0.7	1.205 1.196 0.9	1.262 1.252 1.0	1.141 1.124 1.7	1.244 1.213 3.0	1.145 1.127 1.8	1.263 1.250 1.3	1.203 1.194 0.9	1.163 1.143 1.9	1.243 1.234 0.9	0.679 0.678 0.1	
13		0.327 0.324 0.3	1.037 1.021 1.7	1.243 1.226 1.7	1.335 1.312 2.3	1.242 1.218 2.4	1.263 1.222 4.1	1.220 1.137 8.2	1.251 1.207 4.4	1.242 1.215 2.8	1.333 1.311 2.2	1.241 1.222 1.9	1.037 1.027 1.1	0.332 0.335 -0.3	
14			0.332 0.328 0.5	0.679 0.669 1.0	0.992 0.976 1.5	1.184 1.160 2.4	1.016 0.990 2.6	1.154 1.104 5.0	1.007 0.971 3.5	1.177 1.143 3.4	0.988 0.967 2.1	0.676 0.665 1.1	0.327 0.324 0.3		
15					0.283 0.286 -0.3	0.393 0.387 0.6	0.413 0.403 1.0	0.437 0.424 1.3	0.411 0.398 1.3	0.386 0.376 1.0	0.280 0.274 0.6				

C -M Average Assembly Power, RMS Difference *100 = 1.8

Figure S1 10.4.6-8: Plant S1 MOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.305 0.308 -0.3	0.392 0.397 -0.6	0.399 0.413 -1.4	0.425 0.428 -0.3	0.400 0.402 -0.2	0.396 0.403 -0.7	0.307 0.309 -0.2				
2			0.315 0.328 -1.3	0.671 0.678 -0.8	1.103 1.112 -0.9	1.197 1.208 -1.1	0.952 0.957 -0.5	1.180 1.177 0.2	0.958 0.958 0.0	1.200 1.204 -0.3	1.105 1.107 -0.2	0.673 0.674 -0.1	0.319 0.321 -0.1		
3		0.319 0.324 -0.5	0.962 0.971 -0.9	1.257 1.265 -0.8	1.365 1.371 -0.6	1.177 1.180 -0.3	1.372 1.371 0.1	1.173 1.166 0.6	1.380 1.377 0.3	1.175 1.175 0.0	1.365 1.367 -0.1	1.258 1.260 -0.2	0.962 0.968 -0.6	0.315 0.325 -1.1	
4		0.673 0.686 -1.4	1.258 1.263 -0.5	1.053 1.056 -0.3	1.124 1.125 0.0	1.374 1.372 0.2	1.089 1.084 0.5	1.342 1.331 1.1	1.085 1.083 0.2	1.373 1.372 0.1	1.125 1.125 0.0	1.053 1.055 -0.2	1.257 1.264 -0.7	0.671 0.675 -0.5	
5	0.307 0.311 -0.4	1.104 1.115 -1.0	1.365 1.371 -0.6	1.125 1.126 -0.1	1.363 1.356 0.6	1.066 1.061 0.4	1.004 0.996 0.8	1.046 1.039 0.8	1.005 1.009 -0.4	1.064 1.063 0.1	1.363 1.360 0.3	1.124 1.126 -0.1	1.365 1.374 -0.9	1.103 1.105 -0.1	0.305 0.305 0.0
6	0.396 0.405 -0.9	1.200 1.209 -0.9	1.174 1.178 -0.4	1.373 1.373 0.0	1.064 1.061 0.3	1.355 1.350 0.5	1.094 1.077 1.7	1.339 1.318 2.0	1.097 1.089 0.8	1.355 1.350 0.5	1.066 1.063 0.3	1.374 1.372 0.2	1.177 1.176 0.1	1.197 1.188 0.9	0.392 0.389 0.3
7	0.400 0.404 -0.3	0.958 0.963 -0.5	1.380 1.383 -0.3	1.085 1.085 0.0	1.005 1.000 0.5	1.097 1.083 1.4	1.329 1.283 4.7	0.920 0.903 1.7	1.329 1.314 1.5	1.094 1.090 0.4	1.004 1.000 0.4	1.089 1.086 0.3	1.372 1.370 0.3	0.952 0.946 0.6	0.399 0.396 0.3
8	0.425 0.427 -0.2	1.180 1.183 -0.4	1.173 1.175 -0.2	1.342 1.340 0.2	1.046 1.041 0.6	1.339 1.332 0.7	0.920 0.922 -0.2	0.895 0.884 1.1	0.920 0.903 1.7	1.339 1.312 2.7	1.046 1.039 0.7	1.342 1.334 0.8	1.173 1.172 0.1	1.180 1.166 1.3	0.425 0.422 0.3
9	0.399 0.401 -0.2	0.952 0.956 -0.4	1.372 1.375 -0.3	1.089 1.090 -0.1	1.004 1.003 0.0	1.094 1.092 0.2	1.329 1.325 0.4	0.920 0.908 1.2	1.329 1.291 3.9	1.097 1.081 1.6	1.005 1.011 -0.6	1.085 1.080 0.5	1.380 1.376 0.4	0.958 0.955 0.3	0.400 0.402 -0.2
10	0.392 0.397 -0.5	1.197 1.205 -0.7	1.177 1.181 -0.4	1.374 1.376 -0.3	1.066 1.071 -0.5	1.355 1.354 0.0	1.097 1.097 0.0	1.339 1.330 0.9	1.094 1.080 1.5	1.355 1.340 1.5	1.064 1.056 0.9	1.373 1.355 1.8	1.175 1.171 0.3	1.200 1.203 -0.2	0.396 0.400 -0.4
11	0.305 0.320 -1.5	1.103 1.113 -1.0	1.365 1.370 -0.5	1.124 1.122 0.2	1.363 1.347 1.6	1.064 1.059 0.5	1.005 1.003 0.2	1.046 1.045 0.1	1.004 0.999 0.5	1.066 1.059 0.7	1.363 1.348 1.4	1.125 1.122 0.3	1.365 1.370 -0.5	1.105 1.114 -0.9	0.307 0.321 -1.4
12		0.671 0.674 -0.4	1.257 1.261 -0.4	1.053 1.054 -0.1	1.125 1.122 0.4	1.373 1.369 0.4	1.085 1.083 0.2	1.342 1.340 0.2	1.089 1.092 -0.3	1.374 1.374 0.0	1.124 1.126 -0.1	1.053 1.067 -1.4	1.258 1.272 -1.3	0.673 0.682 -1.0	
13		0.315 0.316 -0.2	0.962 0.966 -0.4	1.258 1.263 -0.5	1.365 1.369 -0.4	1.175 1.176 -0.2	1.380 1.381 -0.1	1.173 1.165 0.7	1.372 1.371 0.1	1.177 1.177 -0.1	1.365 1.372 -0.7	1.257 1.273 -1.6	0.962 0.978 -1.6	0.319 0.336 -1.6	
14			0.319 0.328 -0.9	0.673 0.678 -0.6	1.105 1.114 -1.0	1.200 1.209 -0.9	0.958 0.967 -0.9	1.180 1.183 -0.3	0.952 0.953 0.0	1.197 1.194 0.3	1.103 1.110 -0.6	0.671 0.685 -1.5	0.315 0.321 -0.6		
15					0.307 0.319 -1.2	0.396 0.401 -0.5	0.400 0.405 -0.5	0.425 0.433 -0.8	0.399 0.401 -0.2	0.392 0.391 0.0	0.305 0.306 -0.1				

C -M Average Assembly Power, RMS Difference *100 = 0.9

Figure S1 10.4.6-9: Plant S1 EOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.360 0.364 -0.4	0.452 0.464 -1.2	0.466 0.499 -3.3	0.491 0.502 -1.1	0.466 0.473 -0.7	0.456 0.462 -0.6	0.361 0.365 -0.4				
2			0.376 0.377 -0.1	0.729 0.730 -0.1	1.112 1.118 -0.7	1.183 1.198 -1.6	0.967 0.983 -1.6	1.173 1.182 -0.9	0.970 0.981 -1.1	1.184 1.198 -1.5	1.112 1.121 -0.9	0.730 0.733 -0.3	0.381 0.383 -0.1		
3		0.381 0.380 0.2	1.017 1.011 0.7	1.255 1.251 0.4	1.335 1.336 -0.1	1.136 1.142 -0.6	1.313 1.325 -1.3	1.132 1.149 -1.7	1.315 1.333 -1.8	1.133 1.152 -1.8	1.335 1.344 -0.9	1.255 1.255 0.1	1.017 1.022 -0.4	0.376 0.386 -1.0	
4		0.730 0.729 0.1	1.255 1.238 1.7	1.055 1.046 0.9	1.098 1.092 0.6	1.314 1.312 0.2	1.065 1.067 -0.1	1.299 1.302 -0.3	1.061 1.071 -1.0	1.312 1.323 -1.1	1.098 1.102 -0.4	1.055 1.056 -0.1	1.255 1.257 -0.2	0.729 0.730 -0.1	
5	0.361 0.358 0.4	1.112 1.103 0.9	1.335 1.321 1.3	1.098 1.087 1.1	1.309 1.292 1.7	1.050 1.041 0.8	1.007 1.001 0.6	1.043 1.040 0.3	1.008 1.023 -1.4	1.048 1.052 -0.4	1.309 1.305 0.4	1.098 1.096 0.2	1.335 1.336 -0.1	1.112 1.105 0.7	0.359 0.356 0.3
6	0.456 0.448 0.7	1.184 1.174 1.0	1.133 1.124 0.9	1.312 1.302 1.0	1.048 1.038 1.0	1.319 1.305 1.4	1.081 1.065 1.6	1.306 1.283 2.3	1.084 1.081 0.4	1.319 1.319 0.0	1.050 1.046 0.3	1.314 1.308 0.6	1.136 1.129 0.7	1.183 1.161 2.2	0.452 0.445 0.7
7	0.466 0.464 0.2	0.970 0.965 0.5	1.315 1.308 0.7	1.061 1.058 0.4	1.008 1.002 0.6	1.084 1.074 1.0	1.309 1.280 2.9	0.952 0.941 1.1	1.309 1.302 0.6	1.081 1.081 0.0	1.007 1.003 0.4	1.066 1.058 0.8	1.313 1.306 0.6	0.967 0.954 1.3	0.466 0.459 0.7
8	0.491 0.496 -0.5	1.173 1.168 0.5	1.132 1.127 0.5	1.299 1.294 0.4	1.043 1.040 0.2	1.306 1.312 -0.6	0.952 0.976 -2.4	0.950 0.952 -0.2	0.952 0.946 0.6	1.306 1.292 1.4	1.043 1.037 0.6	1.299 1.281 1.8	1.132 1.136 -0.4	1.173 1.152 2.2	0.491 0.483 0.8
9	0.466 0.465 0.0	0.967 0.958 0.9	1.313 1.306 0.6	1.065 1.063 0.3	1.007 1.009 -0.2	1.081 1.088 -0.6	1.309 1.323 -1.4	0.952 0.954 -0.2	1.309 1.295 1.3	1.084 1.078 0.5	1.008 1.018 -1.0	1.061 1.062 -0.1	1.315 1.318 -0.2	0.970 0.966 0.4	0.466 0.461 0.5
10	0.452 0.455 -0.3	1.183 1.179 0.3	1.136 1.132 0.4	1.314 1.311 0.3	1.050 1.055 -0.6	1.319 1.327 -0.8	1.084 1.095 -1.2	1.306 1.313 -0.7	1.082 1.079 0.2	1.319 1.312 0.7	1.048 1.042 0.6	1.312 1.323 -1.0	1.133 1.140 -0.7	1.184 1.190 -0.6	0.456 0.459 -0.3
11	0.359 0.375 -1.5	1.112 1.112 0.0	1.335 1.328 0.7	1.098 1.090 0.8	1.309 1.293 1.6	1.048 1.049 -0.1	1.008 1.015 -0.7	1.043 1.054 -1.2	1.007 1.011 -0.3	1.050 1.040 0.9	1.309 1.269 4.0	1.098 1.100 -0.1	1.335 1.348 -1.3	1.112 1.126 -1.4	0.361 0.372 -1.1
12		0.729 0.724 0.5	1.255 1.242 1.3	1.055 1.045 1.0	1.098 1.091 0.7	1.312 1.320 -0.8	1.061 1.065 -0.4	1.299 1.301 -0.3	1.066 1.079 -1.4	1.314 1.314 -0.1	1.098 1.095 0.2	1.055 1.078 -2.3	1.255 1.278 -2.2	0.730 0.747 -1.6	
13		0.376 0.371 0.5	1.017 0.997 2.0	1.255 1.240 1.5	1.335 1.321 1.4	1.133 1.134 -0.1	1.315 1.318 -0.2	1.132 1.111 2.0	1.313 1.310 0.2	1.136 1.136 0.0	1.335 1.341 -0.6	1.255 1.274 -1.8	1.017 1.040 -2.3	0.381 0.406 -2.4	
14			0.381 0.374 0.7	0.730 0.724 0.6	1.112 1.111 0.1	1.184 1.193 -0.9	0.970 0.992 -2.2	1.173 1.175 -0.2	0.967 0.966 0.1	1.183 1.179 0.4	1.112 1.116 -0.4	0.729 0.739 -1.0	0.376 0.384 -0.7		
15					0.361 0.369 -0.8	0.456 0.462 -0.6	0.466 0.474 -0.8	0.491 0.494 -0.4	0.466 0.466 -0.1	0.452 0.451 0.1	0.359 0.360 -0.1				

C -M Average Assembly Power, RMS Difference *100 = 1.0

Figure S1 10.4.6-10: Plant S1 BOC 14 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.254 0.254 0.1	0.336 0.335 0.1	0.383 0.391 -0.8	0.419 0.418 0.2	0.382 0.380 0.2	0.331 0.333 -0.2	0.256 0.255 0.1				
2			0.299 0.300 -0.1	0.599 0.599 0.0	0.991 0.987 0.3	1.045 1.034 1.1	1.102 1.094 0.8	1.115 1.101 1.4	1.089 1.078 1.1	1.024 1.016 0.7	0.977 0.971 0.6	0.594 0.590 0.4	0.300 0.298 0.2	Calculated Power Measured Power Difference (C-M)*100	
3		0.300 0.302 -0.2	1.031 1.034 -0.3	1.129 1.132 -0.3	1.184 1.186 -0.2	1.204 1.201 0.3	1.262 1.252 1.0	1.277 1.246 3.1	1.244 1.230 1.4	1.148 1.137 1.1	1.171 1.166 0.6	1.121 1.111 1.0	1.031 1.026 0.5	0.299 0.307 -0.8	
4		0.594 0.603 -0.9	1.121 1.125 -0.4	1.158 1.163 -0.5	1.217 1.227 -1.0	1.272 1.280 -0.8	1.237 1.241 -0.4	1.283 1.290 -0.7	1.216 1.217 -0.1	1.258 1.260 -0.2	1.208 1.210 -0.2	1.158 1.154 0.5	1.129 1.122 0.7	0.599 0.595 0.4	
5	0.256 0.256 0.0	0.977 0.977 0.0	1.171 1.169 0.2	1.208 1.215 -0.7	1.053 1.076 -2.3	1.242 1.260 -1.8	1.293 1.307 -1.3	1.256 1.267 -1.0	1.283 1.294 -1.2	1.241 1.252 -1.1	1.053 1.071 -1.8	1.217 1.217 -0.1	1.184 1.170 1.3	0.991 0.975 1.6	0.255 0.250 0.4
6	0.331 0.331 0.0	1.023 1.016 0.7	1.148 1.127 2.0	1.258 1.260 -0.1	1.241 1.256 -1.6	1.310 1.338 -2.7	1.222 1.237 -1.5	1.296 1.308 -1.2	1.219 1.231 -1.3	1.311 1.325 -1.5	1.243 1.255 -1.2	1.272 1.275 -0.3	1.204 1.192 1.2	1.045 1.017 2.8	0.336 0.328 0.7
7	0.382 0.383 -0.2	1.089 1.085 0.4	1.243 1.236 0.7	1.216 1.216 0.0	1.283 1.294 -1.1	1.218 1.233 -1.4	1.274 1.286 -1.3	1.186 1.198 -1.2	1.274 1.290 -1.6	1.222 1.242 -2.0	1.294 1.308 -1.4	1.237 1.243 -0.7	1.262 1.253 0.9	1.102 1.087 1.5	0.383 0.378 0.5
8	0.419 0.431 -1.2	1.115 1.112 0.2	1.277 1.274 0.3	1.283 1.286 -0.3	1.256 1.266 -1.0	1.295 1.306 -1.0	1.186 1.186 0.0	1.158 1.167 -0.9	1.187 1.201 -1.5	1.296 1.309 -1.3	1.256 1.269 -1.3	1.284 1.304 -2.0	1.277 1.264 1.4	1.115 1.105 1.0	0.419 0.416 0.3
9	0.383 0.382 0.0	1.101 1.087 1.4	1.262 1.259 0.3	1.236 1.241 -0.5	1.293 1.305 -1.2	1.222 1.233 -1.1	1.274 1.285 -1.2	1.186 1.199 -1.3	1.274 1.299 -2.5	1.219 1.230 -1.1	1.283 1.289 -0.6	1.216 1.222 -0.6	1.243 1.241 0.2	1.089 1.087 0.2	0.382 0.384 -0.2
10	0.335 0.337 -0.1	1.044 1.042 0.2	1.203 1.205 -0.1	1.271 1.280 -0.9	1.242 1.260 -1.8	1.310 1.324 -1.5	1.218 1.236 -1.8	1.295 1.305 -1.0	1.222 1.230 -0.8	1.310 1.314 -0.3	1.241 1.241 0.0	1.258 1.260 -0.2	1.148 1.150 -0.2	1.023 1.027 -0.3	0.331 0.334 -0.3
11	0.254 0.264 -1.0	0.990 0.993 -0.3	1.182 1.185 -0.3	1.215 1.221 -0.6	1.052 1.069 -1.7	1.239 1.248 -0.9	1.282 1.286 -0.5	1.256 1.253 0.3	1.293 1.288 0.5	1.242 1.236 0.6	1.053 1.043 1.0	1.208 1.210 -0.2	1.171 1.178 -0.7	0.977 0.985 -0.8	0.256 0.264 -0.8
12		0.598 0.598 0.0	1.127 1.125 0.1	1.155 1.152 0.4	1.205 1.201 0.4	1.256 1.255 0.1	1.214 1.206 0.8	1.282 1.268 1.4	1.236 1.216 2.0	1.272 1.259 1.2	1.216 1.211 0.5	1.158 1.168 -1.0	1.121 1.131 -1.0	0.594 0.602 -0.8	
13		0.299 0.298 0.1	1.028 1.021 0.6	1.116 1.105 1.2	1.166 1.140 2.6	1.143 1.127 1.7	1.240 1.220 2.1	1.275 1.253 2.2	1.261 1.239 2.2	1.204 1.186 1.8	1.183 1.175 0.8	1.129 1.131 -0.2	1.031 1.038 -0.8	0.300 0.312 -1.2	
14			0.298 0.298 0.0	0.589 0.582 0.7	0.965 0.948 1.7	1.016 0.995 2.1	1.085 1.053 3.2	1.113 1.086 2.7	1.100 1.076 2.5	1.044 1.017 2.7	0.990 0.976 1.5	0.599 0.595 0.4	0.299 0.300 -0.1		
15					0.243 0.246 -0.3	0.326 0.321 0.6	0.380 0.369 1.1	0.418 0.404 1.4	0.382 0.373 1.0	0.335 0.327 0.8	0.254 0.250 0.4				

C -M Average Assembly Power, RMS Difference *100 = 1.1

Figure S1 10.4.6-11: Plant S1 MOC 14 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.299 0.302 -0.3	0.384 0.391 -0.7	0.428 0.451 -2.3	0.459 0.469 -1.0	0.429 0.432 -0.3	0.382 0.389 -0.7	0.303 0.304 -0.1				
2			0.322 0.317 0.6	0.658 0.661 -0.4	1.142 1.152 -1.0	1.173 1.185 -1.2	1.213 1.228 -1.5	1.196 1.214 -1.8	1.207 1.207 0.0	1.163 1.156 0.7	1.139 1.136 0.3	0.657 0.658 -0.1	0.323 0.324 -0.1	Calculated Power Measured Power Difference (C-M)*100	
3		0.323 0.328 -0.5	1.039 1.049 -0.9	1.298 1.309 -1.1	1.368 1.379 -1.1	1.131 1.135 -0.4	1.111 1.105 0.6	1.122 1.086 3.6	1.104 1.086 1.8	1.094 1.067 2.7	1.364 1.359 0.5	1.295 1.302 -0.7	1.039 1.043 -0.4	0.322 0.334 -1.2	
4		0.657 0.672 -1.6	1.295 1.314 -1.9	1.087 1.099 -1.1	1.089 1.100 -1.1	1.332 1.335 -0.3	1.098 1.092 0.6	1.358 1.342 1.6	1.087 1.081 0.6	1.327 1.321 0.6	1.088 1.092 -0.4	1.087 1.088 -0.1	1.298 1.291 0.7	0.658 0.656 0.2	
5	0.303 0.306 -0.2	1.139 1.148 -0.9	1.364 1.372 -0.8	1.088 1.097 -0.9	0.872 0.894 -2.2	1.031 1.032 -0.1	1.313 1.305 0.8	1.153 1.146 0.8	1.305 1.320 -1.4	1.032 1.039 -0.7	0.872 0.900 -2.8	1.089 1.090 -0.1	1.368 1.342 2.6	1.142 1.130 1.2	0.299 0.296 0.3
6	0.382 0.384 -0.2	1.163 1.164 -0.1	1.094 1.084 1.0	1.327 1.325 0.3	1.033 1.032 0.1	1.046 1.033 1.3	1.079 1.063 1.6	1.389 1.365 2.3	1.077 1.069 0.8	1.046 1.041 0.5	1.031 1.036 -0.4	1.332 1.333 -0.2	1.131 1.127 0.4	1.173 1.168 0.6	0.384 0.382 0.2
7	0.429 0.433 -0.4	1.208 1.210 -0.2	1.104 1.101 0.3	1.087 1.081 0.6	1.306 1.296 0.9	1.077 1.063 1.4	1.340 1.312 2.8	1.088 1.070 1.9	1.340 1.320 2.0	1.079 1.056 2.3	1.313 1.307 0.6	1.098 1.102 -0.4	1.111 1.124 -1.3	1.213 1.215 -0.3	0.428 0.429 -0.1
8	0.459 0.475 -1.6	1.196 1.202 -0.6	1.122 1.122 0.0	1.358 1.353 0.5	1.154 1.144 1.0	1.389 1.373 1.6	1.089 1.067 2.1	1.032 1.016 1.6	1.089 1.072 1.6	1.389 1.369 2.0	1.154 1.149 0.4	1.358 1.368 -1.0	1.122 1.126 -0.4	1.196 1.196 -0.1	0.459 0.462 -0.3
9	0.428 0.433 -0.5	1.213 1.216 -0.3	1.112 1.113 -0.2	1.098 1.098 0.0	1.313 1.312 0.1	1.079 1.074 0.5	1.340 1.331 1.0	1.089 1.078 1.1	1.340 1.321 2.0	1.077 1.067 1.1	1.305 1.304 0.2	1.087 1.095 -0.8	1.104 1.114 -1.0	1.207 1.220 -1.2	0.429 0.440 -1.1
10	0.384 0.390 -0.6	1.174 1.181 -0.8	1.131 1.136 -0.4	1.332 1.338 -0.5	1.032 1.043 -1.1	1.047 1.049 -0.2	1.077 1.083 -0.6	1.389 1.384 0.5	1.079 1.072 0.7	1.047 1.040 0.7	1.033 1.030 0.3	1.327 1.348 -2.1	1.094 1.110 -1.6	1.163 1.181 -1.8	0.382 0.391 -0.9
11	0.299 0.315 -1.6	1.143 1.154 -1.1	1.369 1.375 -0.6	1.090 1.090 0.0	0.872 0.865 0.7	1.033 1.032 0.1	1.306 1.304 0.2	1.154 1.151 0.3	1.313 1.312 0.1	1.032 1.024 0.7	0.872 0.848 2.4	1.088 1.099 -1.1	1.364 1.386 -2.2	1.139 1.162 -2.3	0.303 0.316 -1.3
12		0.658 0.662 -0.4	1.298 1.302 -0.4	1.087 1.086 0.1	1.088 1.083 0.5	1.327 1.332 -0.5	1.087 1.077 1.0	1.358 1.333 2.5	1.098 1.110 -1.2	1.332 1.333 -0.1	1.090 1.092 -0.2	1.088 1.113 -2.5	1.295 1.322 -2.7	0.657 0.673 -1.7	
13		0.322 0.324 -0.1	1.039 1.042 -0.3	1.293 1.289 0.4	1.361 1.347 1.4	1.092 1.086 0.6	1.104 1.082 2.1	1.122 1.037 8.5	1.112 1.088 2.3	1.131 1.126 0.5	1.369 1.375 -0.6	1.298 1.318 -2.0	1.039 1.063 -2.3	0.323 0.343 -1.9	
14			0.323 0.322 0.0	0.654 0.653 0.1	1.130 1.130 0.0	1.158 1.162 -0.4	1.206 1.220 -1.5	1.195 1.172 2.3	1.213 1.196 1.7	1.174 1.168 0.6	1.143 1.146 -0.4	0.658 0.669 -1.1	0.322 0.329 -0.7		
15					0.290 0.302 -1.2	0.379 0.383 -0.4	0.428 0.433 -0.5	0.459 0.467 -0.8	0.428 0.425 0.2	0.384 0.382 0.2	0.299 0.299 0.0				

C -M Average Assembly Power, RMS Difference *100 = 1.3

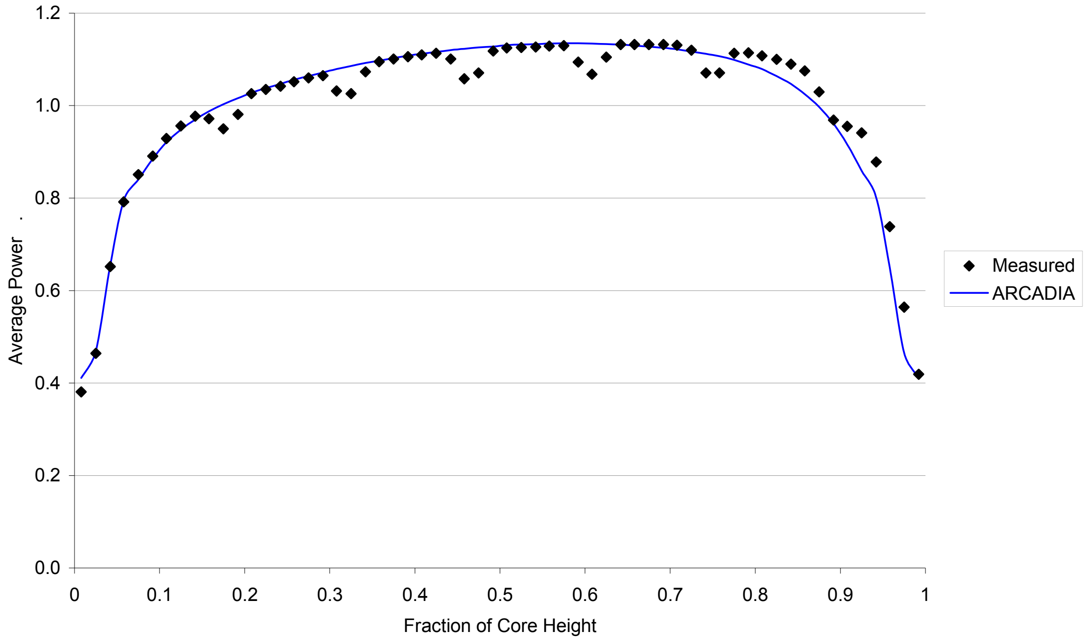
Figure S1 10.4.6-12: Plant S1 EOC 14 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.347 0.348 -0.1	0.444 0.450 -0.5	0.494 0.519 -2.5	0.529 0.540 -1.1	0.498 0.508 -1.0	0.447 0.464 -1.8	0.355 0.362 -0.8				
2			0.363 0.358 0.5	0.693 0.689 0.4	1.144 1.141 0.2	1.198 1.196 0.2	1.237 1.249 -1.2	1.223 1.234 -1.1	1.240 1.257 -1.7	1.200 1.222 -2.2	1.149 1.165 -1.6	0.695 0.701 -0.5	0.365 0.367 -0.2		
3		0.365 0.363 0.2	1.040 1.030 1.0	1.261 1.253 0.7	1.339 1.336 0.3	1.109 1.109 0.0	1.096 1.101 -0.5	1.105 1.116 -1.1	1.095 1.107 -1.2	1.085 1.104 -2.0	1.343 1.359 -1.6	1.262 1.264 -0.2	1.040 1.046 -0.6	0.363 0.375 -1.1	
4		0.695 0.696 -0.1	1.262 1.244 1.8	1.068 1.061 0.7	1.074 1.074 -0.1	1.285 1.285 0.1	1.072 1.069 0.4	1.300 1.290 1.0	1.067 1.067 -0.1	1.287 1.301 -1.4	1.075 1.091 -1.6	1.068 1.075 -0.6	1.260 1.262 -0.1	0.693 0.694 -0.1	
5	0.355 0.351 0.4	1.149 1.137 1.2	1.343 1.326 1.8	1.075 1.069 0.6	0.891 0.905 -1.4	1.027 1.028 -0.1	1.296 1.285 1.1	1.115 1.099 1.6	1.295 1.283 1.2	1.031 1.039 -0.9	0.891 0.924 -3.3	1.073 1.082 -0.9	1.339 1.330 0.9	1.144 1.135 0.9	0.347 0.344 0.3
6	0.446 0.442 0.4	1.200 1.183 1.8	1.085 1.061 2.4	1.287 1.273 1.4	1.031 1.027 0.3	1.040 1.041 -0.1	1.049 1.032 1.7	1.309 1.268 4.1	1.049 1.035 1.3	1.040 1.043 -0.3	1.027 1.038 -1.1	1.285 1.292 -0.7	1.109 1.108 0.2	1.198 1.181 1.7	0.445 0.440 0.5
7	0.498 0.493 0.5	1.240 1.223 1.7	1.095 1.078 1.7	1.067 1.052 1.5	1.295 1.280 1.5	1.049 1.036 1.3	1.270 1.240 2.9	1.042 1.021 2.1	1.270 1.258 1.2	1.049 1.055 -0.6	1.296 1.301 -0.5	1.072 1.077 -0.4	1.096 1.108 -1.2	1.237 1.232 0.6	0.495 0.492 0.3
8	0.529 0.529 0.0	1.223 1.207 1.6	1.105 1.090 1.5	1.300 1.283 1.7	1.115 1.097 1.8	1.309 1.293 1.7	1.042 1.026 1.6	1.002 0.989 1.3	1.042 1.030 1.2	1.309 1.284 2.5	1.115 1.108 0.7	1.300 1.298 0.1	1.105 1.113 -0.8	1.222 1.212 1.1	0.529 0.527 0.2
9	0.495 0.490 0.5	1.237 1.216 2.1	1.096 1.084 1.2	1.073 1.063 0.9	1.296 1.286 1.0	1.050 1.043 0.7	1.270 1.264 0.6	1.042 1.037 0.5	1.270 1.264 0.6	1.049 1.040 0.8	1.295 1.286 0.8	1.067 1.074 -0.8	1.095 1.106 -1.1	1.240 1.247 -0.7	0.498 0.503 -0.5
10	0.445 0.445 -0.1	1.198 1.191 0.8	1.110 1.104 0.6	1.286 1.283 0.3	1.028 1.028 0.0	1.041 1.043 -0.2	1.049 1.057 -0.8	1.309 1.313 -0.3	1.050 1.051 -0.2	1.040 1.041 -0.1	1.031 1.037 -0.6	1.287 1.324 -3.6	1.085 1.105 -2.0	1.200 1.219 -1.9	0.446 0.455 -0.9
11	0.347 0.362 -1.5	1.144 1.145 -0.1	1.340 1.338 0.2	1.074 1.079 -0.4	0.892 0.918 -2.6	1.031 1.037 -0.6	1.295 1.301 -0.5	1.115 1.121 -0.6	1.296 1.306 -0.9	1.027 1.032 -0.4	0.891 0.889 0.2	1.075 1.094 -2.0	1.343 1.370 -2.7	1.149 1.174 -2.5	0.355 0.371 -1.7
12		0.694 0.691 0.2	1.262 1.255 0.7	1.069 1.068 0.2	1.076 1.079 -0.3	1.289 1.282 0.6	1.067 1.065 0.2	1.301 1.301 -0.1	1.073 1.091 -1.8	1.286 1.297 -1.1	1.074 1.084 -1.0	1.068 1.092 -2.3	1.262 1.288 -2.6	0.695 0.712 -1.6	
13		0.364 0.360 0.4	1.041 1.026 1.5	1.263 1.254 0.8	1.344 1.338 0.6	1.086 1.079 0.6	1.096 1.087 0.9	1.106 1.085 2.0	1.097 1.096 0.1	1.110 1.113 -0.4	1.339 1.350 -1.1	1.261 1.279 -1.9	1.041 1.061 -2.0	0.365 0.378 -1.3	
14			0.365 0.364 0.1	0.694 0.690 0.4	1.144 1.138 0.6	1.199 1.192 0.7	1.241 1.231 0.9	1.223 1.215 0.8	1.238 1.234 0.4	1.198 1.194 0.5	1.144 1.149 -0.5	0.693 0.701 -0.8	0.363 0.369 -0.6		
15					0.340 0.339 0.2	0.444 0.441 0.2	0.498 0.497 0.1	0.530 0.536 -0.6	0.495 0.495 0.0	0.445 0.444 0.1	0.347 0.348 -0.1				

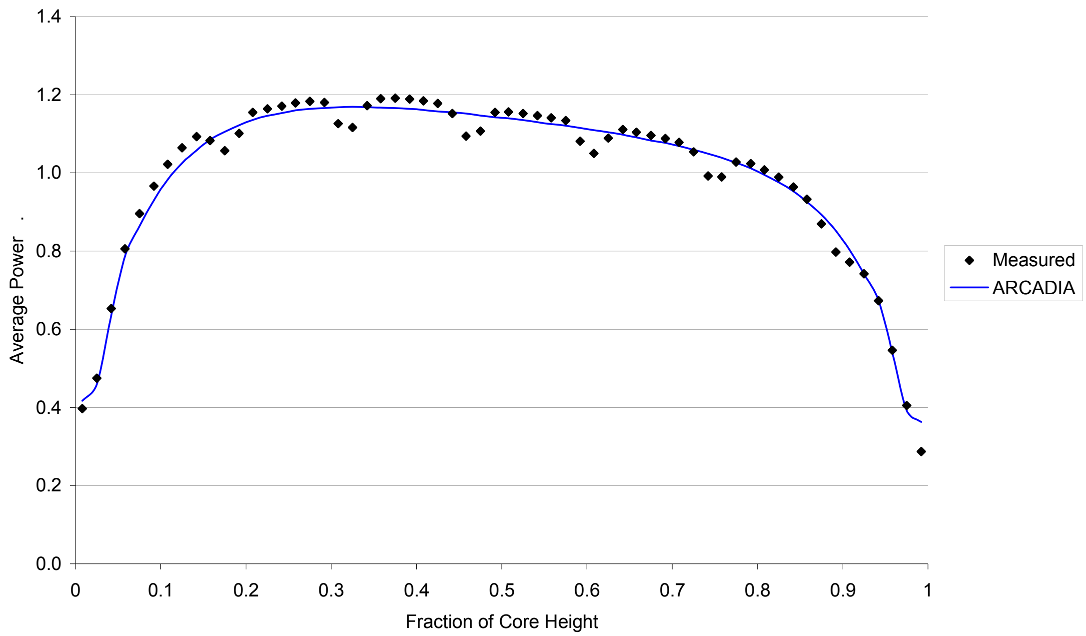
C -M Average Assembly Power, RMS Difference *100 = 1.2

Figure S1 10.4.6-13: Plant S1 BOC 12 Core Average Axial Power Distribution



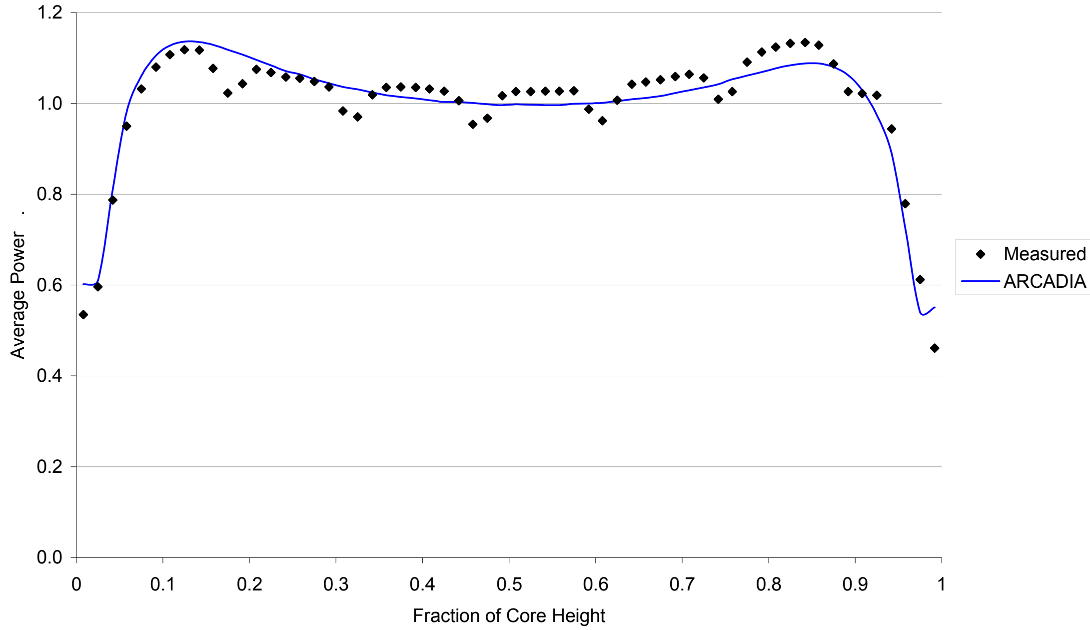
C - M Average Axial Power, RMS Difference *100 = 2.8

Figure S1 10.4.6-14: Plant S1 MOC 12 Core Average Axial Power Distribution



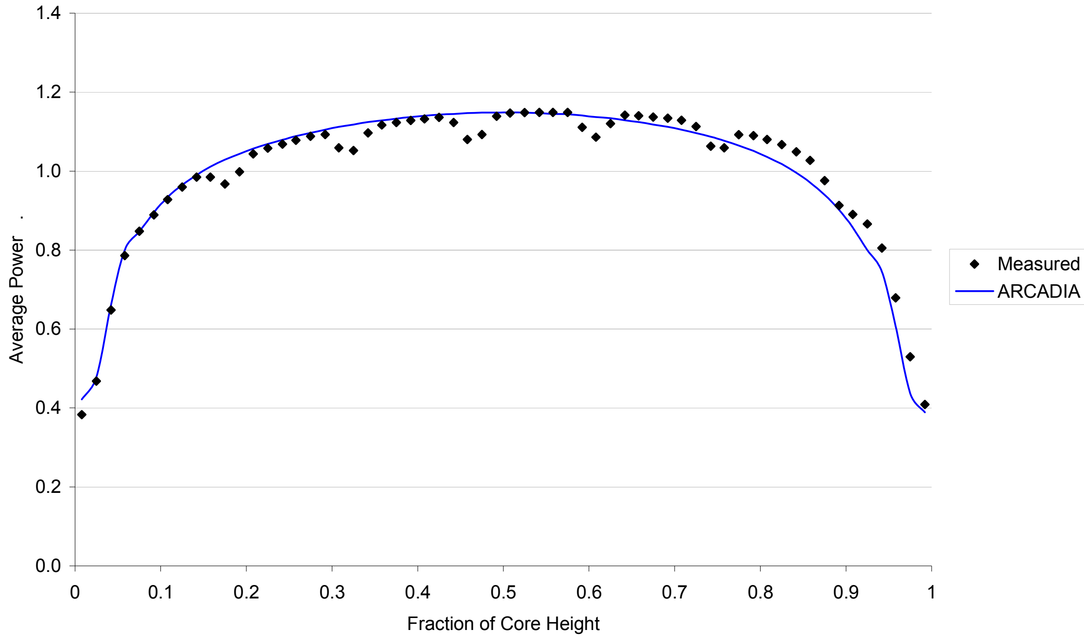
C - M Average Axial Power, RMS Difference *100 = 2.7

Figure S1 10.4.6-15: Plant S1 EOC 12 Core Average Axial Power Distribution



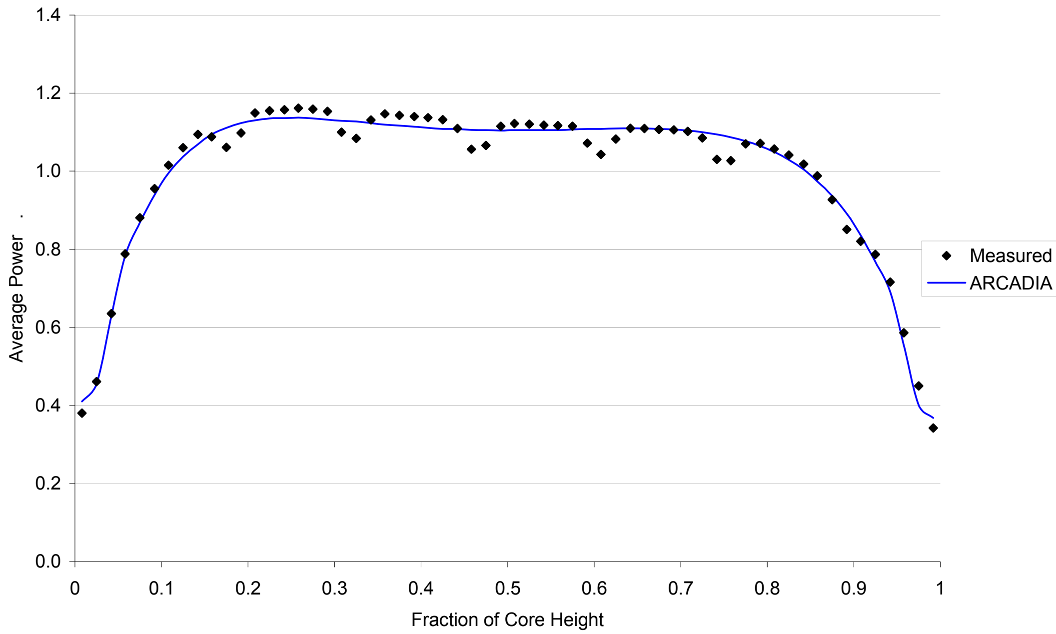
C - M Average Axial Power, RMS Difference *100 = 3.6

Figure S1 10.4.6-16: Plant S1 BOC 13 Core Average Axial Power Distribution



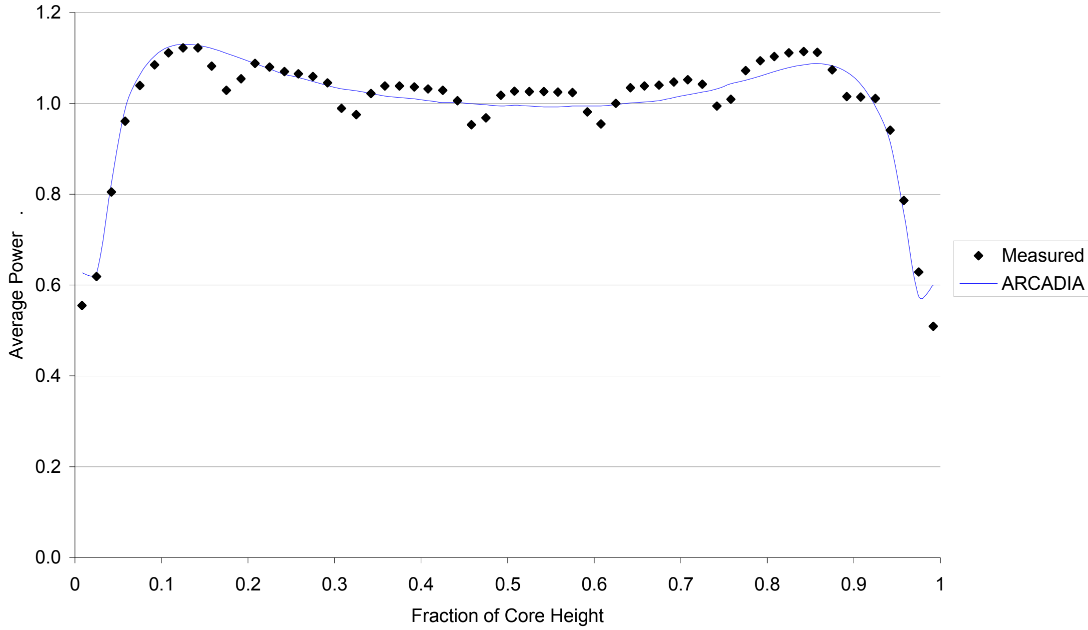
C - M Average Axial Power, RMS Difference *100 = 3.1

Figure S1 10.4.6-17: Plant S1 MOC 13 Core Average Axial Power Distribution



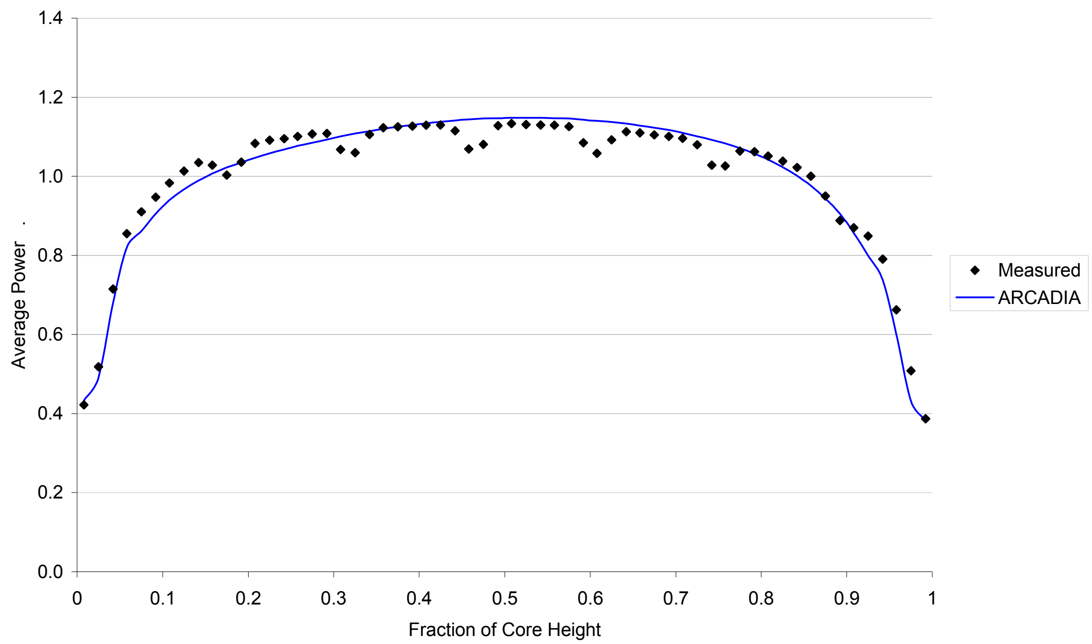
C - M Average Axial Power, RMS Difference *100 = 2.7

Figure S1 10.4.6-18: Plant S1 EOC 13 Core Average Axial Power Distribution



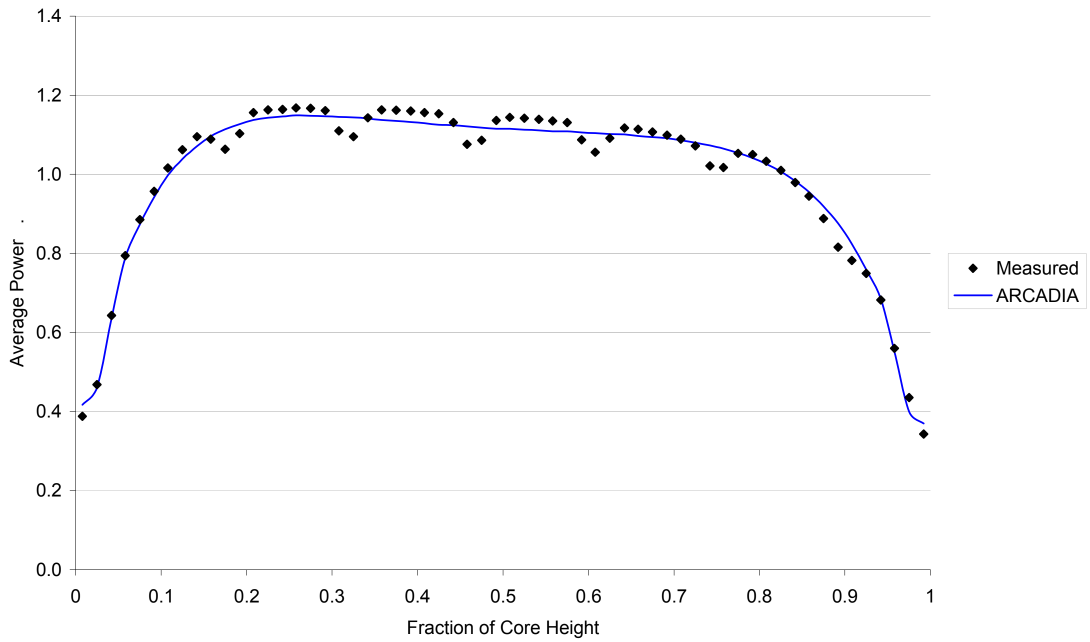
C - M Average Axial Power, RMS Difference *100 = 3.1

Figure S1 10.4.6-19: Plant S1 BOC 14 Core Average Axial Power Distribution



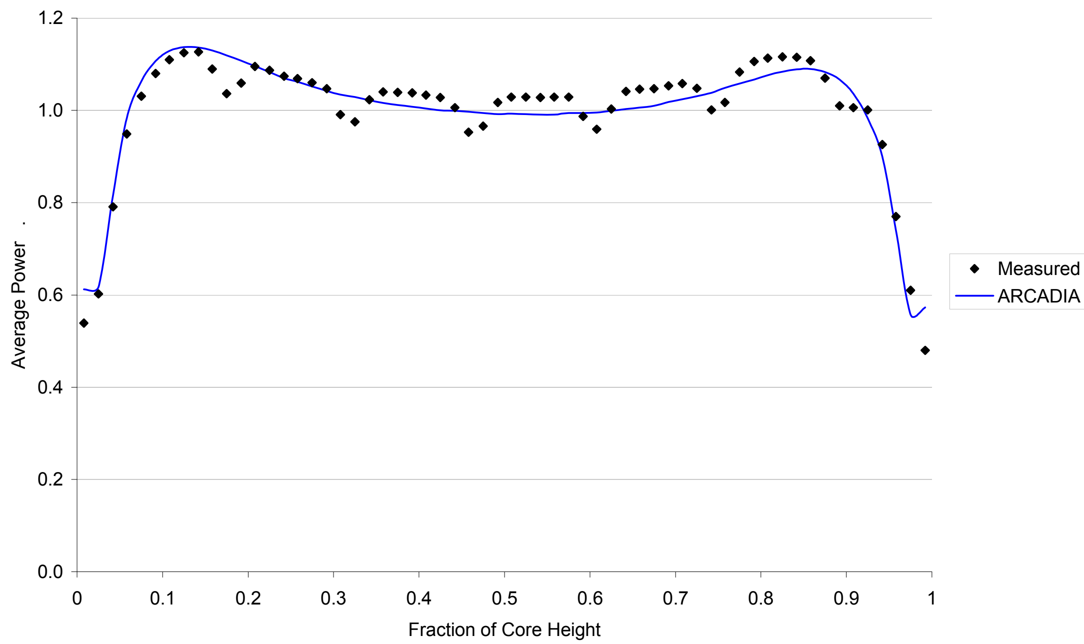
C - M Average Axial Power, RMS Difference *100 = 3.2

Figure S1 10.4.6-20: Plant S1 MOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 2.6

Figure S1 10.4.6-21: Plant S1 EOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 3.3

Appendix S2

Table S2 10.3.7-1: Plant S2 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 12-14

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
12	1859	1868	9
13	1871	1859	-12
14	1885	1867	-18

Table S2 10.3.7-2: Plant S2 Cycle 12 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	350	343	-8	-2.2
CB	462	456	-6	-1.3
CC	733	731	-2	-0.3
CD	1217	1234	17	1.4
SA	620	625	5	0.8
SB	907	889	-19	-2.1
SC	389	391	1	0.3
SD	388	393	5	1.3
Total	5067	5061	-6	-0.1

Table S2 10.3.7-3: Plant S2 Cycle 13 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	399	412	13	3.3
CB	407	448	41	10.0
CC	898	884	-14	-1.5
CD	1142	1156	14	1.3
SA	654	663	9	1.4
SB	733	747	14	1.8
SC	291	323	32	11.0
SD	296	331	35	11.7
Total	4821	4965	144	3.0

Table S2 10.3.7-4: Plant S2 Cycle 14 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
CA	343	369	26	7.6
CB	434	466	32	7.3
CC	778	803	25	3.3
CD	1196	1200	3	0.3
SA	617	613	-3	-0.5
SB	935	930	-5	-0.5
SC	317	338	21	6.6
SD	315	333	18	5.7
Total	4935	5052	117	2.4

Table S2 10.3.7-5: Plant S2 Summary of Total Bank Worth

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
12	5067	5061	-6	-0.1
13	4821	4965	144	3.0
14	4935	5052	117	2.4

Table S2 10.3.7-6: Plant S2 Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 12-14

Cycle	Measured (pcm/ºF)	Calculated (pcm/ºF)	Difference C - M (pcm/ºF)
12	-3.37	-3.12	0.25
13	-3.53	-2.83	0.70
14	-3.25	-2.55	0.69

Figure S2 10.4.7-1: Plant S2 Cycle 12 Critical Boron Concentration vs. Burnup

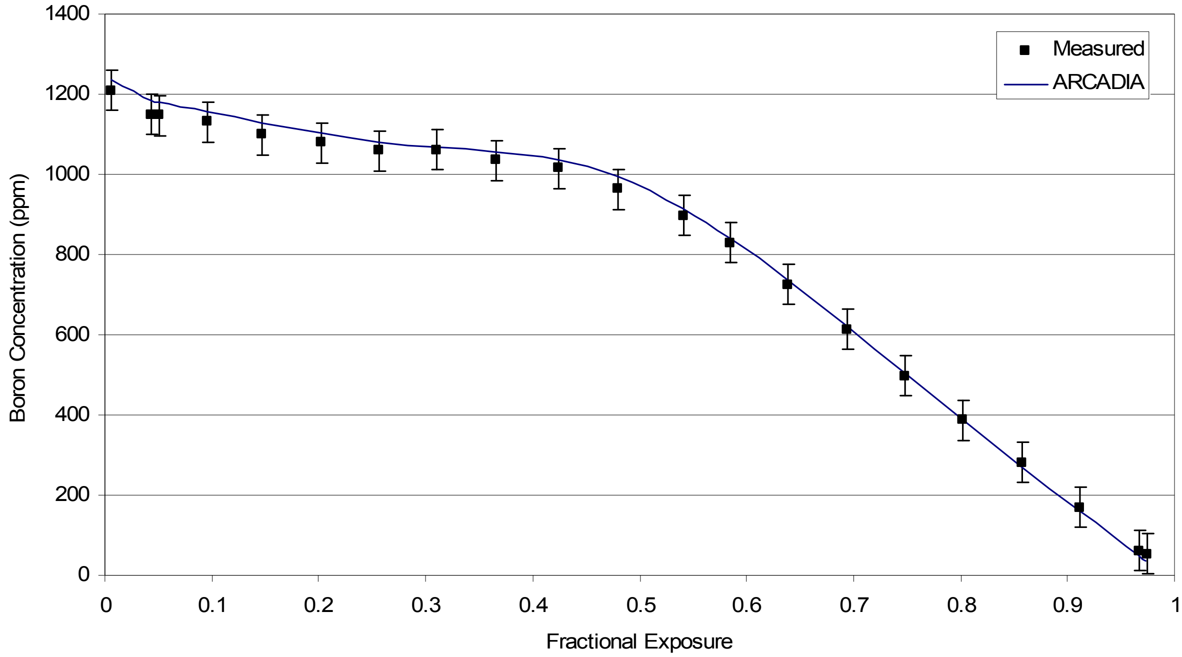


Figure S2 10.4.7-2: Plant S2 Cycle 13 Critical Boron Concentration vs. Burnup

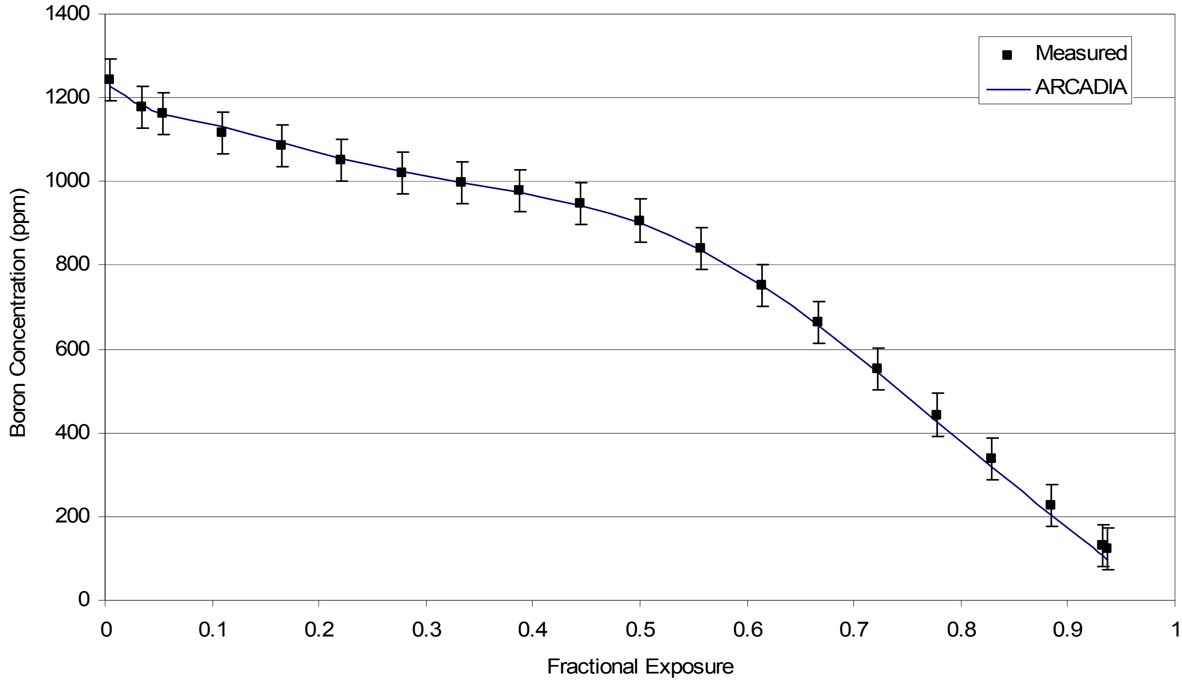


Figure S2 10.4.7-3: Plant S2 Cycle 14 Critical Boron Concentration vs. Burnup

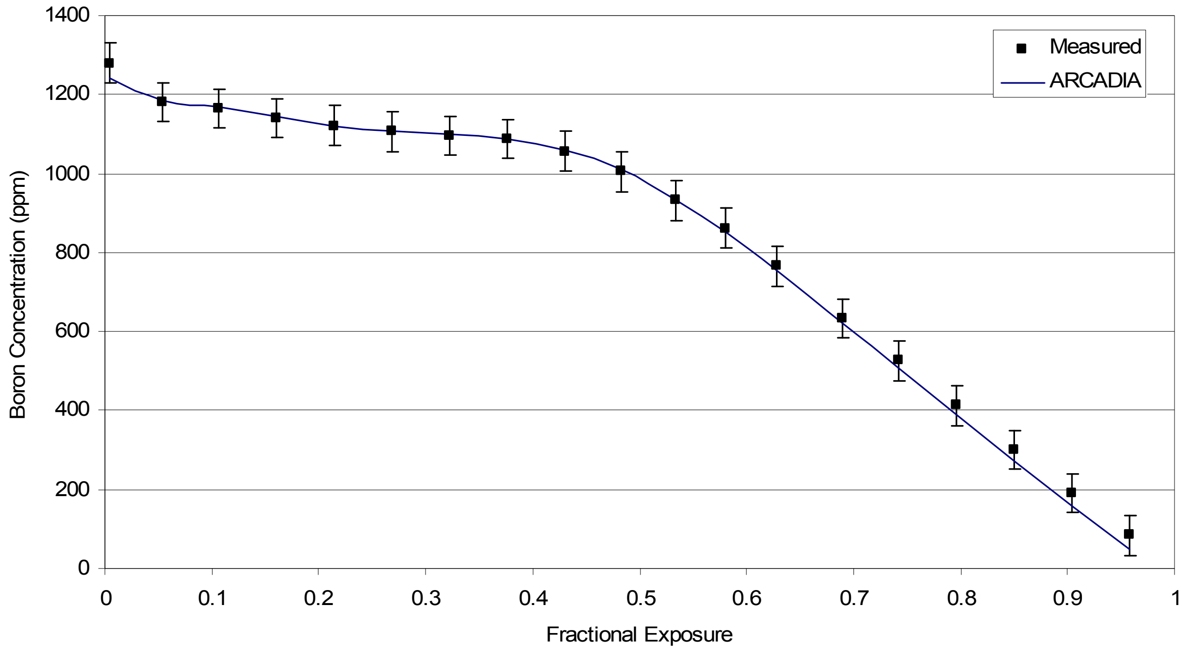


Figure S2 10.4.7-4: Plant S2 BOC 12 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.242 0.240 0.3	0.308 0.305 0.3	0.347 0.353 -0.5	0.449 0.446 0.3	0.350 0.346 0.4	0.325 0.324 0.1	0.246 0.243 0.3				
2			0.331 0.338 -0.7	0.662 0.659 0.3	0.938 0.927 1.1	0.994 0.975 1.9	1.006 0.990 1.6	1.057 1.044 1.2	1.010 0.993 1.7	0.995 0.980 1.5	0.939 0.923 1.6	0.663 0.649 1.3	0.331 0.326 0.5	Calculated Power Measured Power Difference (C-M)*100	
3		0.331 0.333 -0.2	1.071 1.068 0.3	1.193 1.186 0.7	1.290 1.278 1.3	1.214 1.196 1.9	1.247 1.216 3.1	1.273 1.205 6.7	1.237 1.206 3.1	1.208 1.188 2.0	1.288 1.267 2.1	1.196 1.168 2.8	1.071 1.056 1.5	0.331 0.338 -0.7	
4		0.663 0.674 -1.2	1.196 1.186 1.0	1.231 1.226 0.5	1.196 1.188 0.8	1.301 1.289 1.2	1.224 1.210 1.5	1.280 1.265 1.5	1.217 1.203 1.3	1.300 1.288 1.1	1.198 1.187 1.0	1.231 1.216 1.6	1.193 1.178 1.5	0.662 0.656 0.6	
5	0.246 0.251 -0.5	0.939 0.954 -1.6	1.288 1.301 -1.3	1.198 1.204 -0.7	1.297 1.291 0.6	1.213 1.211 0.2	1.172 1.170 0.2	1.265 1.263 0.1	1.194 1.196 -0.3	1.215 1.215 0.0	1.297 1.302 -0.5	1.196 1.189 0.7	1.290 1.274 1.7	0.938 0.925 1.3	0.242 0.239 0.3
6	0.325 0.336 -1.1	0.995 1.019 -2.3	1.208 1.242 -3.3	1.300 1.327 -2.7	1.215 1.229 -1.4	1.273 1.284 -1.1	1.164 1.173 -0.9	1.266 1.274 -0.8	1.166 1.173 -0.7	1.273 1.279 -0.6	1.213 1.217 -0.4	1.301 1.299 0.2	1.214 1.206 0.8	0.994 0.976 1.8	0.308 0.304 0.5
7	0.350 0.360 -1.0	1.010 1.032 -2.1	1.237 1.262 -2.5	1.217 1.261 -4.4	1.194 1.221 -2.7	1.166 1.186 -2.0	1.247 1.266 -2.0	1.144 1.157 -1.4	1.246 1.259 -1.2	1.164 1.175 -1.1	1.172 1.180 -0.7	1.224 1.229 -0.4	1.247 1.251 -0.4	1.006 0.998 0.8	0.347 0.345 0.3
8	0.449 0.466 -1.7	1.057 1.075 -1.9	1.273 1.269 0.4	1.280 1.304 -2.4	1.265 1.298 -3.3	1.266 1.293 -2.8	1.144 1.173 -2.9	1.098 1.115 -1.7	1.144 1.157 -1.3	1.265 1.275 -0.9	1.265 1.277 -1.2	1.280 1.289 -0.8	1.273 1.237 3.6	1.057 1.044 1.3	0.449 0.448 0.1
9	0.347 0.359 -1.1	1.006 1.038 -3.2	1.247 1.264 -1.7	1.224 1.244 -2.0	1.172 1.195 -2.3	1.164 1.185 -2.1	1.247 1.269 -2.2	1.144 1.160 -1.7	1.246 1.265 -1.8	1.166 1.179 -1.3	1.194 1.214 -2.0	1.217 1.221 -0.5	1.237 1.226 1.1	1.010 1.007 0.4	0.350 0.361 -1.1
10	0.308 0.318 -1.0	0.994 1.016 -2.2	1.214 1.232 -1.8	1.301 1.319 -1.8	1.213 1.233 -2.0	1.273 1.290 -1.7	1.166 1.183 -1.6	1.265 1.278 -1.3	1.164 1.174 -0.9	1.273 1.279 -0.6	1.215 1.218 -0.3	1.300 1.300 0.0	1.208 1.203 0.5	0.995 0.994 0.2	0.325 0.329 -0.4
11	0.242 0.259 -1.6	0.938 0.955 -1.7	1.290 1.304 -1.4	1.196 1.205 -0.9	1.297 1.304 -0.7	1.215 1.220 -0.5	1.194 1.198 -0.4	1.265 1.270 -0.5	1.172 1.175 -0.3	1.213 1.210 0.3	1.297 1.284 1.3	1.198 1.188 0.9	1.288 1.281 0.7	0.939 0.937 0.1	0.246 0.254 -0.8
12		0.662 0.668 -0.6	1.193 1.197 -0.4	1.231 1.232 -0.1	1.198 1.194 0.3	1.300 1.294 0.6	1.217 1.206 1.1	1.280 1.263 1.7	1.224 1.226 -0.1	1.301 1.292 0.9	1.196 1.183 1.4	1.231 1.212 1.9	1.196 1.186 1.0	0.663 0.661 0.2	
13		0.331 0.331 0.0	1.071 1.066 0.6	1.196 1.190 0.6	1.288 1.271 1.7	1.208 1.194 1.4	1.237 1.212 2.5	1.273 1.212 6.1	1.247 1.221 2.6	1.214 1.196 1.8	1.290 1.273 1.7	1.193 1.178 1.5	1.071 1.062 0.9	0.331 0.336 -0.5	
14			0.331 0.341 -1.0	0.663 0.663 0.0	0.939 0.935 0.4	0.995 0.987 0.8	1.010 1.000 1.1	1.057 1.030 2.7	1.006 0.985 2.1	0.994 0.976 1.9	0.938 0.924 1.4	0.662 0.653 0.9	0.331 0.328 0.3		
15					0.246 0.258 -1.2	0.325 0.326 0.0	0.350 0.348 0.2	0.449 0.448 0.1	0.347 0.342 0.5	0.308 0.303 0.5	0.242 0.238 0.4				

C -M Average Assembly Power, RMS Difference *100 = 1.6

Figure S2 10.4.7-5: Plant S2 MOC12 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.288 0.287 0.1	0.373 0.373 0.1	0.413 0.424 -1.1	0.525 0.523 0.2	0.416 0.415 0.2	0.395 0.400 -0.5	0.293 0.293 0.0				
2			0.322 0.330 -0.8	0.671 0.671 0.0	1.096 1.090 0.6	1.210 1.198 1.1	1.186 1.176 0.9	1.252 1.237 1.5	1.193 1.183 1.1	1.216 1.211 0.4	1.099 1.096 0.4	0.673 0.669 0.3	0.322 0.322 0.0	Calculated Power Measured Power Difference (C-M)*100	
3		0.322 0.326 -0.4	1.007 1.012 -0.5	1.258 1.258 0.0	1.351 1.345 0.6	1.131 1.120 1.0	1.104 1.086 1.7	1.122 1.079 4.4	1.101 1.086 1.5	1.129 1.123 0.6	1.351 1.346 0.5	1.261 1.254 0.7	1.007 1.009 -0.3	0.322 0.337 -1.5	
4		0.673 0.687 -1.4	1.261 1.265 -0.4	1.103 1.103 0.0	1.080 1.074 0.6	1.322 1.312 0.9	1.043 1.036 0.7	1.245 1.249 -0.4	1.040 1.039 0.0	1.322 1.322 0.1	1.081 1.080 0.1	1.103 1.101 0.2	1.258 1.258 0.0	0.671 0.673 -0.2	
5	0.293 0.297 -0.4	1.099 1.112 -1.2	1.351 1.360 -0.9	1.081 1.083 -0.1	1.337 1.327 1.0	1.076 1.066 1.0	1.018 1.012 0.6	1.288 1.289 -0.1	1.034 1.045 -1.1	1.077 1.081 -0.4	1.337 1.341 -0.4	1.080 1.080 0.0	1.351 1.347 0.4	1.096 1.091 0.5	0.288 0.286 0.2
6	0.395 0.402 -0.7	1.216 1.228 -1.2	1.129 1.140 -1.1	1.322 1.333 -1.0	1.077 1.075 0.3	1.309 1.291 1.8	1.068 1.057 1.1	1.357 1.351 0.6	1.070 1.072 -0.2	1.309 1.315 -0.6	1.076 1.081 -0.5	1.322 1.328 -0.6	1.131 1.132 -0.1	1.210 1.197 1.3	0.373 0.370 0.3
7	0.416 0.423 -0.6	1.193 1.201 -0.7	1.101 1.105 -0.4	1.040 1.063 -2.4	1.034 1.041 -0.7	1.070 1.063 0.7	1.324 1.302 2.2	1.056 1.049 0.7	1.324 1.323 0.1	1.068 1.076 -0.7	1.018 1.027 -0.9	1.043 1.055 -1.2	1.104 1.122 -1.8	1.186 1.185 0.1	0.413 0.412 0.1
8	0.525 0.542 -1.7	1.252 1.254 -0.3	1.122 1.096 2.6	1.245 1.249 -0.4	1.288 1.303 -1.5	1.357 1.359 -0.1	1.056 1.050 0.5	0.969 0.964 0.5	1.056 1.052 0.4	1.357 1.357 0.0	1.288 1.303 -1.5	1.245 1.265 -2.0	1.122 1.104 1.8	1.252 1.243 0.9	0.525 0.526 -0.1
9	0.413 0.419 -0.6	1.186 1.196 -1.0	1.104 1.101 0.3	1.043 1.046 -0.2	1.018 1.024 -0.6	1.068 1.069 -0.1	1.324 1.320 0.4	1.056 1.050 0.6	1.324 1.311 1.3	1.070 1.072 -0.3	1.034 1.060 -2.6	1.040 1.050 -1.0	1.101 1.102 -0.1	1.193 1.199 -0.6	0.416 0.432 -1.6
10	0.373 0.380 -0.6	1.210 1.219 -1.0	1.131 1.134 -0.3	1.322 1.325 -0.4	1.076 1.085 -0.9	1.309 1.310 -0.1	1.070 1.069 0.1	1.357 1.353 0.4	1.068 1.065 0.3	1.309 1.310 -0.1	1.077 1.082 -0.4	1.322 1.322 0.0	1.129 1.134 -0.5	1.216 1.226 -1.1	0.395 0.403 -0.8
11	0.288 0.305 -1.7	1.096 1.106 -1.0	1.351 1.354 -0.3	1.080 1.077 0.2	1.337 1.324 1.3	1.077 1.073 0.5	1.034 1.030 0.5	1.288 1.283 0.4	1.018 1.019 -0.1	1.076 1.076 0.0	1.337 1.331 0.6	1.081 1.084 -0.3	1.351 1.361 -1.0	1.099 1.113 -1.4	0.293 0.308 -1.5
12		0.671 0.673 -0.2	1.258 1.258 0.1	1.103 1.099 0.4	1.081 1.073 0.9	1.322 1.316 0.6	1.040 1.030 0.9	1.245 1.234 1.1	1.043 1.057 -1.4	1.322 1.326 -0.4	1.080 1.082 -0.2	1.103 1.113 -1.0	1.261 1.274 -1.3	0.673 0.682 -0.9	
13		0.322 0.322 0.0	1.007 1.004 0.3	1.261 1.254 0.7	1.351 1.336 1.6	1.129 1.117 1.2	1.101 1.082 1.9	1.122 1.081 4.1	1.104 1.093 1.1	1.131 1.128 0.3	1.351 1.354 -0.3	1.258 1.267 -0.9	1.007 1.018 -1.1	0.322 0.333 -1.1	
14			0.322 0.331 -0.9	0.673 0.672 0.0	1.099 1.096 0.3	1.216 1.206 0.9	1.193 1.178 1.6	1.252 1.232 2.0	1.186 1.173 1.2	1.210 1.201 0.9	1.096 1.096 0.0	0.671 0.677 -0.6	0.322 0.325 -0.3		
15					0.293 0.308 -1.4	0.395 0.395 0.0	0.416 0.414 0.3	0.525 0.529 -0.4	0.413 0.410 0.2	0.373 0.371 0.3	0.288 0.287 0.1				

C -M Average Assembly Power, RMS Difference *100 = 1.0

Figure S2 10.4.7-6: Plant S2 EOC 1 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.329 0.333 -0.4	0.425 0.434 -0.9	0.477 0.500 -2.3	0.591 0.601 -1.0	0.480 0.489 -0.9	0.449 0.462 -1.4	0.335 0.342 -0.7				
2			0.364 0.374 -1.0	0.709 0.716 -0.8	1.098 1.109 -1.1	1.206 1.220 -1.4	1.238 1.254 -1.6	1.258 1.263 -0.6	1.242 1.260 -1.7	1.211 1.235 -2.4	1.101 1.120 -1.9	0.710 0.718 -0.8	0.365 0.369 -0.4		
3		0.365 0.366 -0.2	1.027 1.034 -0.6	1.242 1.250 -0.8	1.343 1.352 -1.0	1.106 1.116 -0.9	1.099 1.110 -1.0	1.124 1.134 -1.0	1.097 1.115 -1.8	1.105 1.133 -2.8	1.342 1.364 -2.1	1.244 1.250 -0.7	1.027 1.040 -1.3	0.364 0.382 -1.8	
4		0.710 0.711 -0.1	1.244 1.243 0.0	1.075 1.079 -0.4	1.048 1.053 -0.5	1.269 1.276 -0.7	1.045 1.052 -0.7	1.299 1.308 -0.9	1.042 1.060 -1.8	1.269 1.294 -2.6	1.049 1.067 -1.8	1.075 1.085 -1.0	1.242 1.252 -1.0	0.709 0.718 -0.9	
5	0.335 0.336 -0.1	1.101 1.103 -0.2	1.342 1.347 -0.5	1.049 1.053 -0.3	1.265 1.267 -0.2	1.037 1.039 -0.2	1.015 1.020 -0.5	1.322 1.336 -1.4	1.029 1.057 -2.8	1.038 1.059 -2.1	1.265 1.291 -2.6	1.048 1.059 -1.0	1.343 1.344 -0.1	1.098 1.104 -0.5	0.329 0.331 -0.2
6	0.449 0.450 -0.2	1.211 1.210 0.1	1.105 1.117 -1.2	1.269 1.273 -0.5	1.038 1.036 0.2	1.248 1.241 0.7	1.034 1.032 0.2	1.302 1.309 -0.7	1.035 1.048 -1.3	1.248 1.267 -1.9	1.037 1.051 -1.4	1.269 1.280 -1.1	1.106 1.114 -0.8	1.206 1.212 -0.6	0.425 0.427 -0.2
7	0.480 0.478 0.2	1.242 1.225 1.7	1.097 1.081 1.6	1.042 1.045 -0.2	1.029 1.020 0.9	1.035 1.025 1.0	1.259 1.243 1.6	1.016 1.015 0.1	1.259 1.265 -0.7	1.034 1.051 -1.6	1.015 1.022 -0.7	1.045 1.051 -0.6	1.099 1.115 -1.6	1.238 1.242 -0.3	0.477 0.478 -0.2
8	0.591 0.594 -0.3	1.258 1.222 3.6	1.124 1.062 6.2	1.299 1.266 3.3	1.322 1.293 2.9	1.302 1.289 1.3	1.016 1.018 -0.2	0.944 0.942 0.3	1.016 1.010 0.6	1.302 1.287 1.5	1.322 1.315 0.7	1.299 1.291 0.8	1.124 1.084 4.0	1.258 1.247 1.1	0.591 0.592 -0.1
9	0.477 0.468 0.9	1.238 1.196 4.2	1.099 1.062 3.7	1.045 1.022 2.4	1.015 0.999 1.6	1.034 1.027 0.8	1.259 1.257 0.2	1.016 1.010 0.6	1.259 1.240 1.8	1.035 1.026 0.9	1.029 1.023 0.6	1.042 1.035 0.7	1.097 1.084 1.3	1.242 1.239 0.3	0.480 0.492 -1.2
10	0.425 0.420 0.6	1.206 1.178 2.8	1.106 1.082 2.4	1.269 1.247 2.2	1.037 1.027 1.0	1.248 1.243 0.5	1.035 1.042 -0.7	1.302 1.296 0.6	1.034 1.028 0.6	1.248 1.242 0.5	1.038 1.034 0.4	1.269 1.263 0.6	1.105 1.102 0.3	1.211 1.213 -0.2	0.449 0.455 -0.6
11	0.329 0.338 -0.9	1.098 1.082 1.6	1.343 1.320 2.2	1.048 1.036 1.3	1.265 1.259 0.6	1.038 1.034 0.4	1.029 1.024 0.5	1.322 1.306 1.6	1.015 1.017 -0.2	1.037 1.039 -0.2	1.265 1.266 -0.1	1.049 1.050 -0.1	1.342 1.347 -0.4	1.101 1.109 -0.8	0.335 0.347 -1.3
12		0.709 0.698 1.1	1.242 1.221 2.0	1.075 1.063 1.2	1.049 1.044 0.5	1.269 1.266 0.3	1.042 1.036 0.7	1.299 1.290 0.9	1.045 1.074 -2.9	1.269 1.279 -1.0	1.048 1.053 -0.4	1.075 1.080 -0.5	1.244 1.252 -0.8	0.710 0.717 -0.7	
13		0.364 0.357 0.7	1.027 1.005 2.3	1.244 1.231 1.2	1.342 1.337 0.6	1.105 1.099 0.5	1.097 1.083 1.3	1.124 1.085 3.8	1.099 1.094 0.5	1.106 1.106 0.0	1.343 1.346 -0.4	1.242 1.251 -0.9	1.027 1.038 -1.0	0.365 0.376 -1.1	
14			0.365 0.374 -0.9	0.710 0.710 0.0	1.101 1.103 -0.2	1.211 1.209 0.2	1.242 1.237 0.5	1.258 1.239 1.9	1.238 1.226 1.2	1.206 1.195 1.1	1.098 1.099 -0.1	0.709 0.720 -1.1	0.364 0.369 -0.5		
15					0.335 0.348 -1.3	0.449 0.451 -0.2	0.480 0.479 0.2	0.591 0.585 0.6	0.477 0.473 0.4	0.425 0.422 0.3	0.329 0.329 0.0				

Calculated Power
Measured Power
Difference (C-M)*100

C -M Average Assembly Power, RMS Difference *100 = 1.4

Figure S2 10.4.7-7: Plant S2 BOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.268 0.265 0.3	0.345 0.340 0.5	0.396 0.394 0.2	0.360 0.353 0.7	0.369 0.362 0.7	0.313 0.308 0.5	0.243 0.238 0.5				
2			0.319 0.323 -0.4	0.664 0.662 0.2	1.004 0.995 0.9	1.038 1.018 2.0	1.023 1.006 1.7	1.087 1.061 2.6	0.934 0.914 2.1	0.982 0.958 2.4	0.931 0.909 2.2	0.516 0.503 1.3	0.291 0.285 0.6		
3		0.292 0.293 -0.1	0.963 0.961 0.3	1.175 1.172 0.2	1.192 1.188 0.4	1.220 1.211 0.9	1.264 1.250 1.5	1.175 1.151 2.4	1.242 1.217 2.5	1.200 1.165 3.5	1.167 1.141 2.7	1.131 1.099 3.2	0.961 0.943 1.7	0.318 0.324 -0.6	
4		0.520 0.527 -0.7	1.136 1.125 1.1	1.156 1.158 -0.1	1.158 1.163 -0.5	1.300 1.304 -0.3	1.210 1.207 0.3	1.284 1.271 1.4	1.215 1.205 1.0	1.310 1.296 1.5	1.237 1.223 1.4	1.154 1.136 1.8	1.173 1.153 1.9	0.663 0.656 0.7	
5	0.250 0.252 -0.1	0.944 0.953 -0.9	1.175 1.184 -0.9	1.241 1.255 -1.4	1.206 1.226 -2.0	1.285 1.304 -1.9	1.304 1.315 -1.2	1.247 1.253 -0.6	1.308 1.317 -1.0	1.294 1.297 -0.3	1.205 1.211 -0.7	1.157 1.149 0.8	1.191 1.169 2.2	1.004 0.990 1.4	0.268 0.265 0.3
6	0.342 0.338 0.3	1.001 1.013 -1.3	1.209 1.230 -2.1	1.315 1.340 -2.5	1.296 1.326 -3.0	1.244 1.286 -4.1	1.217 1.240 -2.3	1.332 1.348 -1.7	1.229 1.243 -1.3	1.243 1.254 -1.0	1.284 1.292 -0.8	1.301 1.301 -0.1	1.220 1.214 0.6	1.039 1.029 1.0	0.346 0.343 0.2
7	0.378 0.386 -0.7	0.946 0.962 -1.6	1.249 1.273 -2.4	1.219 1.248 -2.9	1.310 1.341 -3.2	1.230 1.261 -3.1	1.286 1.312 -2.6	1.217 1.237 -2.0	1.286 1.305 -1.9	1.217 1.234 -1.6	1.304 1.318 -1.4	1.211 1.221 -0.9	1.266 1.274 -0.8	1.025 1.027 -0.2	0.397 0.399 -0.1
8	0.363 0.380 -1.7	1.094 1.113 -1.9	1.179 1.201 -2.2	1.287 1.313 -2.6	1.248 1.280 -3.1	1.332 1.361 -2.9	1.217 1.241 -2.4	1.284 1.306 -2.2	1.217 1.240 -2.3	1.332 1.362 -3.0	1.248 1.268 -2.0	1.287 1.303 -1.5	1.179 1.190 -1.1	1.094 1.102 -0.8	0.363 0.367 -0.5
9	0.397 0.405 -0.7	1.025 1.032 -0.7	1.266 1.283 -1.6	1.211 1.231 -2.0	1.304 1.330 -2.6	1.217 1.239 -2.1	1.286 1.306 -2.0	1.217 1.237 -2.0	1.286 1.312 -2.6	1.230 1.252 -2.2	1.310 1.332 -2.2	1.219 1.233 -1.4	1.249 1.261 -1.2	0.946 0.957 -1.1	0.378 0.393 -1.4
10	0.346 0.352 -0.6	1.039 1.048 -0.9	1.220 1.231 -1.1	1.301 1.316 -1.5	1.284 1.310 -2.6	1.243 1.258 -1.4	1.229 1.242 -1.2	1.332 1.345 -1.3	1.217 1.230 -1.3	1.244 1.256 -1.2	1.296 1.308 -1.2	1.315 1.324 -0.9	1.209 1.216 -0.8	1.001 1.009 -0.8	0.342 0.348 -0.6
11	0.268 0.282 -1.4	1.004 1.011 -0.7	1.191 1.193 -0.2	1.157 1.159 -0.2	1.205 1.208 -0.4	1.294 1.292 0.2	1.308 1.307 0.1	1.247 1.253 -0.6	1.304 1.304 -0.1	1.285 1.285 0.0	1.206 1.210 -0.3	1.241 1.240 0.1	1.175 1.176 -0.1	0.944 0.948 -0.4	0.250 0.256 -0.6
12		0.663 0.661 0.2	1.173 1.162 1.1	1.154 1.139 1.5	1.237 1.216 2.1	1.310 1.285 2.5	1.215 1.197 1.9	1.284 1.265 2.0	1.210 1.195 1.5	1.300 1.285 1.6	1.158 1.146 1.2	1.156 1.140 1.6	1.136 1.128 0.9	0.520 0.519 0.1	
13		0.318 0.314 0.4	0.961 0.939 2.2	1.131 1.103 2.8	1.167 1.121 4.7	1.200 1.166 3.4	1.242 1.208 3.4	1.175 1.132 4.3	1.264 1.231 3.3	1.220 1.190 3.0	1.192 1.167 2.4	1.175 1.153 2.1	0.963 0.951 1.2	0.292 0.292 0.0	
14			0.291 0.293 -0.3	0.516 0.505 1.1	0.931 0.905 2.6	0.982 0.955 2.7	0.934 0.908 2.7	1.087 1.054 3.3	1.023 0.990 3.3	1.038 0.994 4.4	1.004 0.974 3.1	0.664 0.646 1.8	0.319 0.313 0.5		
15					0.243 0.247 -0.4	0.313 0.307 0.6	0.369 0.361 0.8	0.360 0.357 0.3	0.396 0.385 1.1	0.345 0.333 1.2	0.268 0.260 0.8				

C -M Average Assembly Power, RMS Difference *100 = 1.8

Figure S2 10.4.7-8: Plant S2 MOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.298 0.296 0.2	0.377 0.374 0.3	0.401 0.404 -0.3	0.360 0.357 0.2	0.380 0.379 0.1	0.349 0.353 -0.4	0.276 0.275 0.1				
2			0.333 0.341 -0.8	0.692 0.693 -0.1	1.108 1.103 0.5	1.186 1.172 1.5	0.992 0.985 0.7	1.108 1.094 1.4	0.921 0.914 0.7	1.139 1.133 0.7	1.042 1.034 0.8	0.553 0.545 0.7	0.308 0.304 0.3		
3		0.309 0.311 -0.2	0.991 0.993 -0.2	1.284 1.285 -0.1	1.311 1.309 0.2	1.198 1.194 0.4	1.330 1.327 0.4	1.121 1.116 0.6	1.311 1.306 0.5	1.183 1.173 1.0	1.282 1.270 1.1	1.238 1.216 2.2	0.989 0.981 0.8	0.333 0.343 -1.0	
4		0.556 0.566 -0.9	1.243 1.239 0.4	1.075 1.076 -0.2	1.050 1.052 -0.2	1.376 1.380 -0.4	1.155 1.159 -0.4	1.383 1.387 -0.5	1.160 1.163 -0.4	1.383 1.384 -0.1	1.112 1.111 0.1	1.073 1.064 0.9	1.282 1.270 1.2	0.691 0.688 0.4	
5	0.283 0.282 0.1	1.054 1.060 -0.7	1.289 1.295 -0.6	1.115 1.123 -0.8	0.999 1.005 -0.6	1.093 1.105 -1.2	1.314 1.326 -1.2	1.174 1.183 -0.9	1.318 1.336 -1.8	1.099 1.109 -1.0	0.998 1.013 -1.5	1.049 1.048 0.2	1.310 1.293 1.7	1.108 1.095 1.3	0.298 0.295 0.3
6	0.378 0.368 1.0	1.156 1.162 -0.6	1.189 1.200 -1.1	1.386 1.406 -2.0	1.100 1.119 -1.9	1.024 1.053 -2.9	1.089 1.105 -1.7	1.410 1.419 -0.8	1.099 1.110 -1.1	1.024 1.034 -1.1	1.093 1.102 -0.9	1.376 1.379 -0.3	1.198 1.195 0.3	1.187 1.171 1.5	0.377 0.373 0.4
7	0.388 0.393 -0.5	0.929 0.940 -1.1	1.317 1.337 -2.0	1.162 1.190 -2.8	1.319 1.345 -2.6	1.099 1.122 -2.3	1.307 1.336 -2.8	1.151 1.164 -1.3	1.307 1.320 -1.3	1.089 1.104 -1.5	1.315 1.324 -0.9	1.156 1.162 -0.6	1.332 1.348 -1.7	0.993 0.995 -0.2	0.402 0.402 0.0
8	0.362 0.380 -1.9	1.112 1.127 -1.5	1.124 1.143 -1.9	1.385 1.408 -2.4	1.174 1.195 -2.1	1.411 1.431 -2.0	1.151 1.162 -1.1	1.376 1.387 -1.1	1.151 1.158 -0.7	1.411 1.408 0.3	1.174 1.177 -0.2	1.385 1.383 0.1	1.124 1.129 -0.6	1.112 1.119 -0.7	0.362 0.365 -0.3
9	0.402 0.407 -0.6	0.993 0.992 0.1	1.332 1.343 -1.1	1.156 1.169 -1.3	1.315 1.331 -1.6	1.089 1.100 -1.1	1.307 1.316 -0.8	1.151 1.158 -0.7	1.307 1.318 -1.0	1.099 1.103 -0.3	1.319 1.324 -0.5	1.162 1.162 0.0	1.317 1.320 -0.3	0.929 0.935 -0.6	0.388 0.399 -1.1
10	0.377 0.383 -0.6	1.187 1.193 -0.6	1.198 1.205 -0.6	1.376 1.385 -0.9	1.093 1.106 -1.3	1.024 1.029 -0.5	1.099 1.101 -0.2	1.410 1.413 -0.3	1.089 1.091 -0.2	1.024 1.025 -0.1	1.100 1.102 -0.1	1.386 1.380 0.6	1.189 1.188 0.1	1.156 1.160 -0.4	0.378 0.383 -0.5
11	0.298 0.316 -1.8	1.108 1.115 -0.7	1.310 1.311 -0.1	1.049 1.049 0.1	0.998 0.995 0.3	1.099 1.093 0.6	1.318 1.312 0.6	1.174 1.172 0.1	1.314 1.310 0.4	1.093 1.090 0.3	0.999 1.005 -0.6	1.115 1.108 0.7	1.289 1.283 0.6	1.054 1.055 -0.2	0.283 0.293 -1.0
12		0.691 0.690 0.1	1.282 1.273 0.9	1.073 1.061 1.1	1.112 1.095 1.8	1.383 1.360 2.2	1.160 1.146 1.4	1.383 1.367 1.5	1.155 1.144 1.1	1.376 1.361 1.5	1.050 1.038 1.2	1.075 1.051 2.3	1.243 1.229 1.4	0.556 0.554 0.2	
13		0.333 0.329 0.3	0.989 0.973 1.6	1.238 1.215 2.3	1.282 1.244 3.8	1.183 1.159 2.4	1.311 1.288 2.3	1.121 1.098 2.4	1.330 1.308 2.2	1.198 1.177 2.1	1.311 1.287 2.3	1.284 1.259 2.4	0.991 0.978 1.3	0.309 0.312 -0.3	
14			0.308 0.311 -0.4	0.553 0.545 0.8	1.042 1.022 2.0	1.139 1.120 2.0	0.921 0.908 1.3	1.108 1.091 1.7	0.992 0.974 1.9	1.186 1.156 3.1	1.108 1.084 2.5	0.692 0.675 1.7	0.333 0.327 0.6		
15					0.276 0.282 -0.5	0.349 0.345 0.3	0.380 0.377 0.3	0.360 0.363 -0.3	0.401 0.396 0.5	0.377 0.368 0.9	0.298 0.291 0.7				

C -M Average Assembly Power, RMS Difference *100 = 1.2

Figure S2 10.4.7-9: Plant S2 EOC 13 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.345 0.348 -0.2	0.422 0.428 -0.5	0.448 0.464 -1.6	0.407 0.415 -0.8	0.436 0.447 -1.1	0.407 0.428 -2.1	0.336 0.346 -1.0				
2			0.387 0.399 -1.2	0.747 0.752 -0.5	1.151 1.156 -0.5	1.164 1.171 -0.7	0.994 1.003 -0.9	1.106 1.118 -1.2	0.945 0.961 -1.6	1.158 1.187 -2.9	1.134 1.161 -2.7	0.632 0.645 -1.4	0.367 0.376 -0.9		
3		0.367 0.366 0.1	1.048 1.049 -0.1	1.307 1.308 -0.1	1.345 1.347 -0.2	1.156 1.158 -0.2	1.345 1.349 -0.4	1.103 1.107 -0.4	1.345 1.361 -1.6	1.162 1.189 -2.7	1.351 1.380 -2.9	1.296 1.321 -2.6	1.049 1.076 -2.7	0.387 0.416 -2.9	
4		0.631 0.625 0.6	1.293 1.283 1.0	1.069 1.064 0.4	1.026 1.024 0.2	1.301 1.299 0.2	1.110 1.105 0.4	1.342 1.330 1.2	1.117 1.121 -0.4	1.313 1.331 -1.9	1.087 1.108 -2.1	1.070 1.088 -1.7	1.309 1.329 -2.1	0.748 0.763 -1.5	
5	0.340 0.331 0.8	1.134 1.121 1.4	1.348 1.337 1.1	1.085 1.077 0.8	0.963 0.957 0.5	1.043 1.039 0.4	1.294 1.284 1.0	1.113 1.104 0.9	1.297 1.296 0.1	1.049 1.058 -0.9	0.964 0.990 -2.6	1.027 1.038 -1.1	1.346 1.352 -0.6	1.151 1.159 -0.8	0.345 0.347 -0.2
6	0.434 0.409 2.5	1.162 1.144 1.8	1.160 1.155 0.5	1.310 1.298 1.2	1.047 1.038 0.9	0.983 0.983 0.0	1.039 1.022 1.6	1.302 1.285 1.7	1.047 1.038 0.9	0.984 0.982 0.2	1.043 1.046 -0.3	1.301 1.303 -0.2	1.156 1.155 0.1	1.164 1.165 -0.1	0.422 0.422 0.0
7	0.441 0.434 0.7	0.947 0.934 1.3	1.342 1.326 1.7	1.115 1.096 1.9	1.295 1.273 2.2	1.046 1.025 2.1	1.285 1.236 4.8	1.090 1.066 2.4	1.285 1.265 2.0	1.039 1.025 1.3	1.294 1.283 1.0	1.109 1.100 0.9	1.344 1.332 1.1	0.993 0.988 0.5	0.448 0.447 0.1
8	0.408 0.417 -0.9	1.105 1.091 1.4	1.101 1.085 1.6	1.340 1.317 2.3	1.112 1.088 2.4	1.301 1.274 2.8	1.089 1.059 3.1	1.317 1.290 2.7	1.089 1.069 2.1	1.301 1.271 3.1	1.112 1.096 1.6	1.340 1.317 2.3	1.101 1.102 0.0	1.105 1.097 0.8	0.408 0.408 0.0
9	0.448 0.445 0.3	0.993 0.971 2.2	1.344 1.324 2.0	1.109 1.094 1.5	1.294 1.275 1.9	1.039 1.023 1.6	1.285 1.265 2.0	1.090 1.075 1.5	1.285 1.264 2.1	1.046 1.033 1.4	1.295 1.284 1.1	1.115 1.106 0.9	1.342 1.342 0.1	0.947 0.949 -0.2	0.441 0.451 -1.0
10	0.422 0.422 0.0	1.164 1.152 1.2	1.156 1.144 1.2	1.301 1.290 1.2	1.043 1.036 0.7	0.984 0.978 0.6	1.047 1.041 0.6	1.302 1.300 0.2	1.039 1.037 0.2	0.983 0.983 0.1	1.047 1.048 -0.1	1.310 1.305 0.5	1.160 1.163 -0.3	1.162 1.171 -0.9	0.434 0.442 -0.8
11	0.345 0.359 -1.4	1.151 1.147 0.4	1.346 1.337 0.9	1.027 1.023 0.4	0.964 0.970 -0.6	1.049 1.050 -0.2	1.297 1.303 -0.6	1.113 1.129 -1.7	1.294 1.309 -1.5	1.043 1.054 -1.2	0.963 0.984 -2.1	1.085 1.093 -0.9	1.348 1.360 -1.2	1.134 1.149 -1.5	0.340 0.355 -1.5
12		0.748 0.743 0.5	1.309 1.298 1.1	1.070 1.066 0.5	1.087 1.087 0.0	1.313 1.315 -0.2	1.117 1.124 -0.7	1.342 1.356 -1.5	1.110 1.132 -2.3	1.301 1.318 -1.6	1.026 1.038 -1.2	1.069 1.078 -1.0	1.293 1.307 -1.4	0.631 0.640 -1.0	
13		0.387 0.383 0.4	1.049 1.034 1.5	1.296 1.290 0.6	1.351 1.348 0.3	1.162 1.167 -0.5	1.345 1.356 -1.1	1.103 1.106 -0.4	1.345 1.357 -1.2	1.156 1.163 -0.7	1.345 1.354 -0.9	1.307 1.317 -1.0	1.048 1.060 -1.3	0.367 0.381 -1.4	
14			0.367 0.381 -1.3	0.632 0.636 -0.4	1.134 1.145 -1.1	1.158 1.173 -1.4	0.945 0.966 -2.0	1.106 1.116 -1.1	0.994 0.998 -0.5	1.164 1.159 0.5	1.151 1.152 -0.1	0.747 0.746 0.1	0.387 0.389 -0.2		
15					0.336 0.353 -1.8	0.407 0.416 -0.9	0.436 0.445 -0.8	0.407 0.412 -0.4	0.448 0.451 -0.2	0.422 0.422 0.1	0.345 0.345 0.0				

C -M Average Assembly Power, RMS Difference *100 = 1.4

Figure S2 10.4.7-10: Plant S2 BOC 14 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.250 0.251 -0.1	0.350 0.351 -0.1	0.403 0.409 -0.7	0.393 0.394 0.0	0.404 0.405 -0.1	0.344 0.350 -0.5	0.267 0.268 -0.1				
2			0.314 0.332 -1.8	0.591 0.600 -0.9	0.946 0.949 -0.3	0.995 0.990 0.5	1.049 1.046 0.3	1.130 1.122 0.7	1.047 1.044 0.4	1.007 1.006 0.1	0.964 0.963 0.1	0.597 0.596 0.1	0.317 0.318 -0.1		
3		0.317 0.325 -0.8	1.055 1.072 -1.7	1.111 1.123 -1.2	1.153 1.160 -0.6	1.272 1.272 -0.1	1.278 1.274 0.4	1.265 1.251 1.4	1.249 1.243 0.6	1.310 1.305 0.5	1.162 1.160 0.2	1.119 1.114 0.5	1.056 1.060 -0.5	0.315 0.328 -1.4	
4		0.597 0.619 -2.2	1.119 1.128 -0.9	1.177 1.187 -1.0	1.225 1.235 -1.0	1.274 1.279 -0.5	1.214 1.215 0.0	1.282 1.275 0.7	1.221 1.222 -0.1	1.282 1.284 -0.3	1.207 1.211 -0.4	1.178 1.180 -0.2	1.113 1.118 -0.5	0.592 0.597 -0.5	
5	0.267 0.272 -0.5	0.963 0.978 -1.5	1.161 1.173 -1.1	1.207 1.219 -1.2	1.182 1.198 -1.6	1.195 1.204 -0.9	1.262 1.269 -0.6	1.281 1.287 -0.6	1.269 1.281 -1.2	1.232 1.242 -1.0	1.184 1.196 -1.2	1.226 1.233 -0.7	1.156 1.161 -0.6	0.948 0.949 -0.1	0.250 0.251 0.0
6	0.344 0.354 -1.0	1.006 1.016 -1.0	1.309 1.317 -0.8	1.281 1.291 -1.0	1.231 1.243 -1.2	1.258 1.265 -0.7	1.201 1.211 -1.0	1.255 1.268 -1.3	1.205 1.218 -1.3	1.258 1.272 -1.4	1.196 1.206 -1.0	1.276 1.283 -0.6	1.276 1.281 -0.4	0.997 0.991 0.6	0.351 0.350 0.1
7	0.404 0.410 -0.6	1.047 1.049 -0.2	1.247 1.246 0.1	1.219 1.227 -0.7	1.267 1.280 -1.3	1.204 1.216 -1.2	1.236 1.248 -1.2	1.166 1.179 -1.3	1.236 1.251 -1.5	1.201 1.220 -1.9	1.261 1.270 -0.9	1.214 1.218 -0.4	1.280 1.289 -0.9	1.050 1.047 0.4	0.403 0.402 0.1
8	0.393 0.406 -1.2	1.130 1.123 0.7	1.265 1.245 2.1	1.280 1.281 -0.1	1.275 1.296 -2.1	1.253 1.271 -1.8	1.166 1.190 -2.4	1.126 1.140 -1.4	1.166 1.179 -1.3	1.253 1.265 -1.1	1.275 1.278 -0.2	1.280 1.271 0.9	1.265 1.248 1.7	1.130 1.114 1.6	0.393 0.391 0.2
9	0.403 0.404 0.0	1.050 1.036 1.5	1.280 1.269 1.0	1.214 1.215 -0.1	1.261 1.271 -1.0	1.201 1.213 -1.2	1.236 1.250 -1.4	1.166 1.177 -1.2	1.236 1.248 -1.2	1.204 1.209 -0.5	1.267 1.265 0.2	1.219 1.212 0.8	1.247 1.236 1.1	1.047 1.040 0.7	0.404 0.409 -0.5
10	0.351 0.354 -0.3	0.997 0.993 0.4	1.276 1.272 0.4	1.276 1.277 -0.1	1.196 1.202 -0.5	1.258 1.265 -0.6	1.205 1.212 -0.7	1.255 1.261 -0.6	1.201 1.205 -0.4	1.258 1.258 0.0	1.231 1.227 0.3	1.281 1.269 1.1	1.309 1.299 0.9	1.006 1.002 0.4	0.344 0.345 -0.2
11	0.250 0.264 -1.4	0.948 0.950 -0.2	1.156 1.154 0.1	1.226 1.228 -0.2	1.184 1.198 -1.5	1.232 1.232 0.0	1.269 1.267 0.2	1.281 1.282 -0.1	1.262 1.257 0.5	1.195 1.191 0.5	1.182 1.181 0.0	1.207 1.198 0.8	1.161 1.155 0.6	0.963 0.962 0.1	0.267 0.272 -0.6
12		0.592 0.592 0.0	1.113 1.109 0.4	1.178 1.170 0.8	1.207 1.196 1.1	1.282 1.262 2.0	1.221 1.205 1.6	1.282 1.262 2.0	1.214 1.196 1.8	1.274 1.258 1.6	1.225 1.212 1.3	1.177 1.161 1.6	1.119 1.112 0.6	0.597 0.599 -0.2	
13		0.315 0.314 0.1	1.056 1.050 0.6	1.119 1.105 1.4	1.162 1.131 3.1	1.310 1.282 2.8	1.249 1.221 2.7	1.265 1.229 3.7	1.278 1.249 2.9	1.272 1.246 2.6	1.153 1.136 1.7	1.111 1.100 1.1	1.055 1.053 0.2	0.317 0.332 -1.5	
14			0.317 0.328 -1.0	0.597 0.593 0.4	0.964 0.948 1.6	1.007 0.987 2.0	1.047 1.022 2.6	1.130 1.102 2.8	1.049 1.022 2.7	0.995 0.961 3.4	0.946 0.926 2.0	0.591 0.587 0.4	0.314 0.314 0.1		
15					0.267 0.274 -0.7	0.344 0.341 0.4	0.404 0.397 0.7	0.393 0.391 0.2	0.403 0.394 0.9	0.350 0.340 1.0	0.250 0.244 0.5				

Calculated Power
Measured Power
Difference (C-M)*100

C -M Average Assembly Power, RMS Difference *100 = 1.2

Figure S2 10.4.7-11: Plant S2 MOC 14 Assembly Average Radial Power Distribution

Calculated Power
Measured Power
Difference (C-M)*100

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.280 0.280 0.1	0.397 0.397 0.0	0.447 0.463 -1.5	0.428 0.432 -0.4	0.448 0.453 -0.5	0.389 0.399 -1.0	0.297 0.299 -0.2				
2			0.304 0.318 -1.3	0.606 0.610 -0.3	1.058 1.054 0.3	1.159 1.146 1.4	1.193 1.195 -0.2	1.221 1.223 -0.1	1.189 1.196 -0.7	1.167 1.175 -0.8	1.072 1.073 -0.1	0.610 0.606 0.5	0.307 0.305 0.1		
3		0.307 0.312 -0.6	0.980 0.984 -0.4	1.211 1.214 -0.3	1.236 1.237 -0.1	1.183 1.183 0.1	1.142 1.146 -0.4	1.123 1.134 -1.1	1.114 1.123 -0.8	1.211 1.218 -0.7	1.243 1.242 0.1	1.217 1.196 2.0	0.980 0.978 0.2	0.304 0.319 -1.4	
4		0.610 0.635 -2.5	1.217 1.207 1.0	1.060 1.061 -0.1	1.071 1.077 -0.6	1.303 1.307 -0.4	1.097 1.103 -0.6	1.328 1.341 -1.3	1.100 1.110 -1.0	1.307 1.319 -1.2	1.055 1.063 -0.9	1.060 1.060 0.1	1.211 1.213 -0.1	0.607 0.610 -0.4	
5	0.297 0.301 -0.5	1.072 1.085 -1.3	1.242 1.246 -0.4	1.055 1.061 -0.6	0.989 1.006 -1.7	1.075 1.079 -0.5	1.326 1.330 -0.4	1.203 1.210 -0.7	1.331 1.344 -1.3	1.103 1.118 -1.5	0.990 1.017 -2.8	1.072 1.081 -0.9	1.238 1.241 -0.3	1.059 1.058 0.1	0.281 0.280 0.1
6	0.389 0.398 -0.9	1.167 1.175 -0.8	1.211 1.216 -0.5	1.306 1.311 -0.5	1.103 1.107 -0.4	1.334 1.328 0.6	1.150 1.148 0.2	1.346 1.345 0.0	1.154 1.162 -0.7	1.334 1.349 -1.5	1.075 1.088 -1.3	1.304 1.313 -0.9	1.186 1.191 -0.4	1.161 1.152 0.9	0.398 0.396 0.2
7	0.448 0.452 -0.4	1.189 1.189 0.0	1.113 1.112 0.2	1.099 1.101 -0.2	1.329 1.330 -0.1	1.153 1.150 0.3	1.339 1.329 1.0	1.094 1.093 0.0	1.339 1.345 -0.6	1.150 1.165 -1.5	1.324 1.334 -0.9	1.097 1.102 -0.5	1.143 1.156 -1.4	1.194 1.190 0.4	0.448 0.446 0.2
8	0.428 0.436 -0.8	1.221 1.212 0.9	1.124 1.108 1.5	1.327 1.321 0.6	1.199 1.200 -0.1	1.344 1.343 0.0	1.094 1.097 -0.3	1.012 1.012 0.0	1.094 1.094 0.0	1.344 1.344 0.0	1.199 1.198 0.1	1.327 1.318 0.9	1.124 1.117 0.7	1.221 1.204 1.7	0.428 0.427 0.1
9	0.448 0.445 0.3	1.194 1.172 2.2	1.143 1.129 1.3	1.097 1.091 0.6	1.324 1.320 0.4	1.150 1.148 0.1	1.339 1.339 0.0	1.094 1.092 0.2	1.339 1.331 0.8	1.153 1.151 0.3	1.329 1.324 0.5	1.099 1.093 0.6	1.113 1.110 0.4	1.189 1.187 0.1	0.448 0.461 -1.3
10	0.398 0.398 0.0	1.161 1.150 1.1	1.186 1.177 1.0	1.304 1.296 0.8	1.075 1.069 0.6	1.334 1.331 0.4	1.154 1.155 -0.1	1.346 1.344 0.2	1.150 1.148 0.2	1.334 1.333 0.1	1.103 1.102 0.0	1.306 1.297 0.9	1.211 1.209 0.2	1.167 1.170 -0.3	0.389 0.394 -0.5
11	0.281 0.294 -1.3	1.059 1.056 0.3	1.238 1.230 0.8	1.072 1.067 0.5	0.990 0.995 -0.5	1.103 1.099 0.4	1.331 1.327 0.4	1.203 1.202 0.2	1.326 1.325 0.0	1.075 1.077 -0.2	0.989 1.003 -1.4	1.055 1.057 -0.2	1.242 1.246 -0.4	1.072 1.079 -0.8	0.297 0.307 -1.0
12		0.607 0.603 0.3	1.211 1.201 1.0	1.060 1.050 1.0	1.055 1.043 1.2	1.307 1.290 1.7	1.100 1.092 0.8	1.328 1.324 0.4	1.097 1.098 -0.1	1.303 1.301 0.2	1.071 1.072 -0.1	1.060 1.059 0.1	1.217 1.222 -0.5	0.610 0.618 -0.7	
13		0.304 0.302 0.2	0.980 0.970 1.0	1.217 1.199 1.8	1.243 1.212 3.1	1.211 1.192 1.9	1.114 1.102 1.2	1.123 1.117 0.6	1.142 1.135 0.7	1.183 1.174 1.0	1.236 1.229 0.7	1.211 1.208 0.2	0.980 0.986 -0.6	0.307 0.324 -1.7	
14			0.307 0.315 -0.8	0.610 0.605 0.5	1.072 1.059 1.3	1.167 1.152 1.6	1.189 1.171 1.8	1.221 1.213 0.9	1.193 1.180 1.3	1.159 1.135 2.4	1.058 1.044 1.3	0.606 0.600 0.6	0.304 0.304 0.0		
15					0.297 0.308 -1.1	0.389 0.388 0.1	0.448 0.446 0.2	0.428 0.438 -1.0	0.447 0.445 0.2	0.397 0.391 0.6	0.280 0.277 0.4				

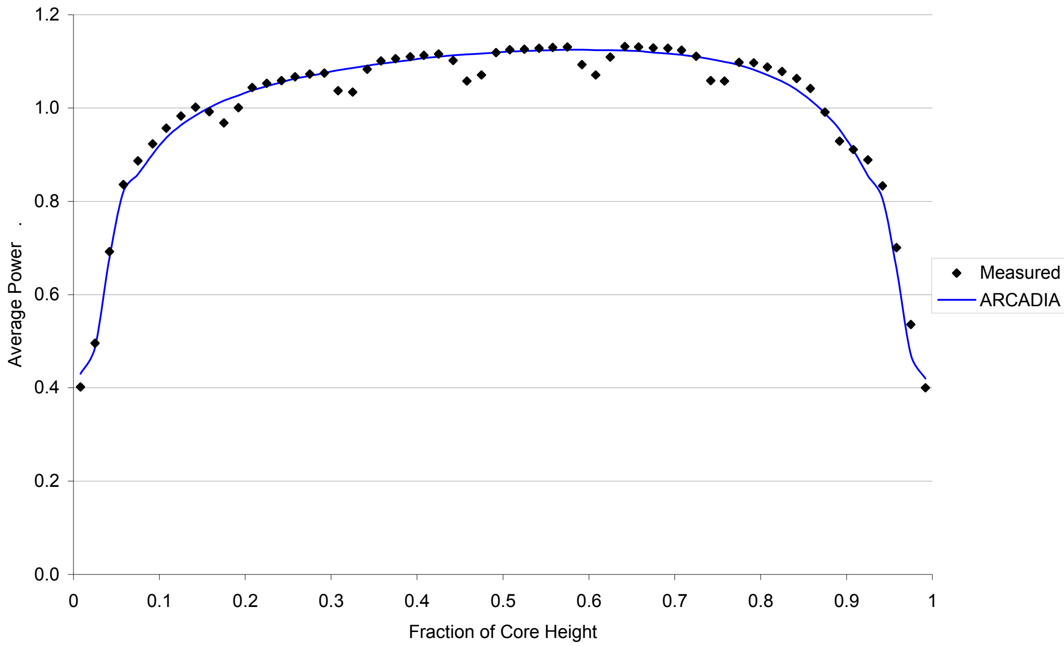
C -M Average Assembly Power, RMS Difference *100 = 0.9

Figure S2 10.4.7-12: Plant S2 EOC 14 Assembly Average Radial Power Distribution

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					0.348 0.347 0.0	0.476 0.478 -0.2	0.519 0.535 -1.6	0.488 0.495 -0.7	0.519 0.527 -0.8	0.464 0.481 -1.6	0.363 0.369 -0.6				
2			0.368 0.382 -1.4	0.687 0.689 -0.2	1.121 1.117 0.4	1.209 1.200 0.9	1.206 1.209 -0.4	1.189 1.194 -0.5	1.201 1.212 -1.1	1.208 1.224 -1.5	1.125 1.135 -1.0	0.688 0.690 -0.2	0.370 0.371 -0.2	Calculated Power Measured Power Difference (C-M)*100	
3		0.370 0.372 -0.3	1.028 1.029 -0.1	1.256 1.254 0.2	1.310 1.305 0.5	1.161 1.155 0.6	1.099 1.098 0.1	1.071 1.077 -0.6	1.074 1.080 -0.7	1.179 1.192 -1.3	1.308 1.316 -0.8	1.256 1.253 0.2	1.027 1.033 -0.6	0.368 0.383 -1.5	
4		0.688 0.699 -1.1	1.256 1.246 1.1	1.080 1.075 0.6	1.072 1.066 0.6	1.254 1.244 1.0	1.047 1.038 0.9	1.248 1.237 1.1	1.046 1.044 0.2	1.252 1.258 -0.6	1.054 1.063 -0.8	1.080 1.083 -0.3	1.255 1.259 -0.4	0.687 0.690 -0.4	
5	0.363 0.365 -0.1	1.125 1.126 -0.1	1.308 1.301 0.7	1.055 1.050 0.5	0.976 0.972 0.4	1.031 1.017 1.4	1.267 1.248 1.9	1.123 1.107 1.6	1.267 1.255 1.2	1.052 1.054 -0.2	0.977 0.995 -1.8	1.072 1.077 -0.5	1.309 1.308 0.1	1.121 1.116 0.4	0.348 0.346 0.2
6	0.464 0.469 -0.5	1.208 1.206 0.2	1.179 1.171 0.9	1.252 1.245 0.7	1.052 1.042 1.0	1.247 1.218 2.9	1.076 1.051 2.5	1.274 1.241 3.3	1.078 1.065 1.3	1.247 1.245 0.2	1.031 1.034 -0.4	1.254 1.256 -0.3	1.162 1.162 0.0	1.209 1.194 1.5	0.477 0.472 0.5
7	0.519 0.522 -0.4	1.201 1.197 0.4	1.073 1.067 0.7	1.046 1.046 0.1	1.267 1.261 0.6	1.078 1.062 1.6	1.246 1.208 3.8	1.030 1.010 2.0	1.246 1.232 1.3	1.076 1.075 0.1	1.266 1.264 0.2	1.047 1.047 0.0	1.099 1.112 -1.3	1.206 1.200 0.6	0.519 0.516 0.3
8	0.488 0.502 -1.4	1.189 1.181 0.8	1.072 1.057 1.5	1.248 1.245 0.3	1.121 1.129 -0.8	1.273 1.270 0.3	1.030 1.026 0.4	0.970 0.961 0.9	1.030 1.020 1.1	1.273 1.257 1.7	1.121 1.113 0.9	1.248 1.232 1.5	1.072 1.072 0.0	1.189 1.174 1.6	0.488 0.487 0.1
9	0.519 0.517 0.1	1.206 1.183 2.2	1.099 1.088 1.1	1.047 1.045 0.2	1.266 1.270 -0.4	1.076 1.078 -0.2	1.246 1.248 -0.2	1.030 1.028 0.2	1.246 1.235 1.1	1.078 1.072 0.6	1.267 1.262 0.5	1.046 1.041 0.5	1.073 1.074 0.0	1.201 1.203 -0.2	0.519 0.531 -1.3
10	0.477 0.478 -0.1	1.209 1.201 0.8	1.162 1.157 0.5	1.254 1.253 0.0	1.031 1.035 -0.5	1.247 1.254 -0.7	1.078 1.089 -1.1	1.274 1.282 -0.8	1.076 1.079 -0.3	1.247 1.251 -0.4	1.052 1.057 -0.5	1.252 1.249 0.3	1.179 1.184 -0.5	1.208 1.217 -0.9	0.464 0.471 -0.8
11	0.348 0.362 -1.4	1.121 1.121 0.0	1.309 1.307 0.3	1.072 1.074 -0.2	0.977 0.991 -1.5	1.052 1.058 -0.6	1.267 1.278 -1.1	1.123 1.139 -1.6	1.267 1.279 -1.3	1.031 1.043 -1.2	0.976 1.004 -2.8	1.055 1.067 -1.1	1.308 1.321 -1.3	1.125 1.140 -1.5	0.363 0.376 -1.3
12		0.687 0.685 0.2	1.255 1.249 0.6	1.080 1.077 0.3	1.054 1.053 0.1	1.252 1.247 0.4	1.046 1.049 -0.3	1.248 1.258 -1.0	1.047 1.058 -1.1	1.254 1.265 -1.1	1.072 1.085 -1.3	1.080 1.093 -1.2	1.256 1.272 -1.6	0.688 0.700 -1.2	
13		0.368 0.365 0.3	1.027 1.015 1.2	1.256 1.247 0.8	1.308 1.296 1.2	1.179 1.173 0.6	1.074 1.072 0.2	1.071 1.076 -0.4	1.099 1.103 -0.4	1.161 1.163 -0.2	1.310 1.315 -0.5	1.256 1.264 -0.8	1.028 1.041 -1.4	0.370 0.387 -1.7	
14			0.370 0.379 -1.0	0.688 0.688 0.0	1.125 1.123 0.2	1.208 1.203 0.5	1.201 1.191 1.0	1.189 1.191 -0.2	1.206 1.205 0.1	1.209 1.197 1.3	1.121 1.117 0.4	0.687 0.682 0.5	0.368 0.370 -0.2		
15					0.363 0.373 -1.0	0.464 0.466 -0.2	0.519 0.520 -0.1	0.488 0.501 -1.3	0.519 0.521 -0.2	0.476 0.473 0.3	0.348 0.346 0.2				

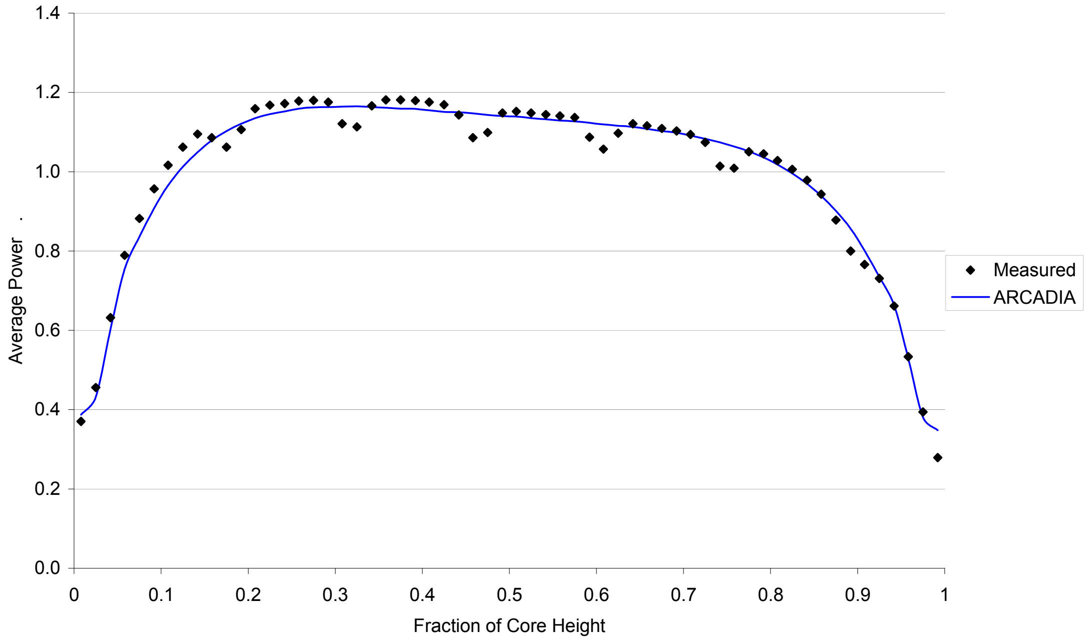
C -M Average Assembly Power, RMS Difference *100 = 1.0

Figure S2 10.4.7-13: Plant S2 BOC 12 Core Average Axial Power Distribution



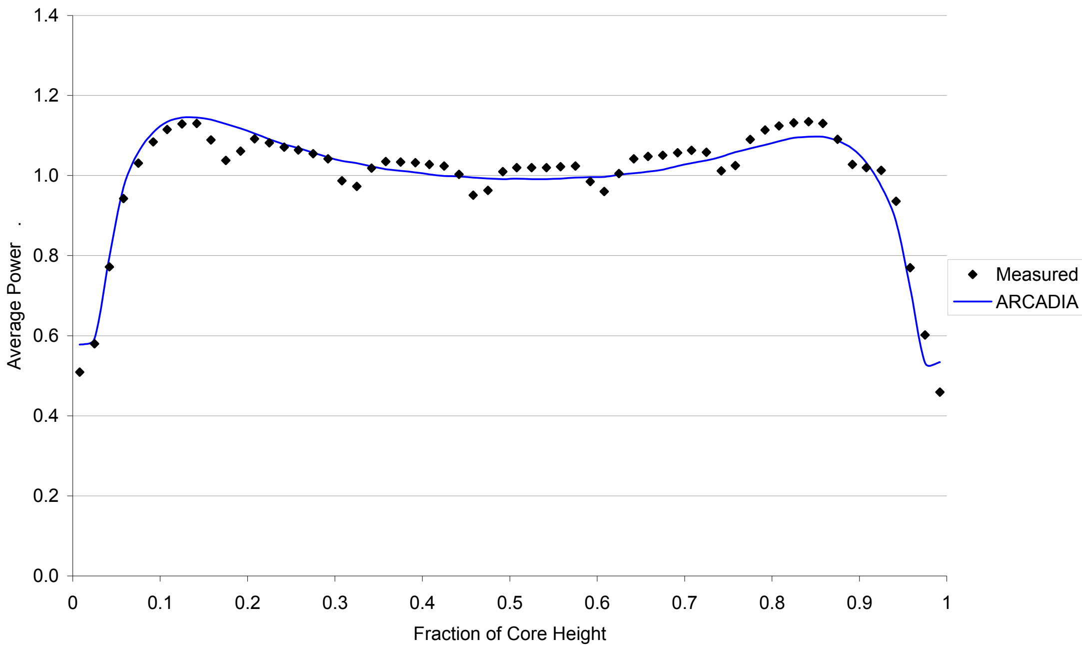
C - M Average Axial Power, RMS Difference *100 = 2.4

Figure S2 10.4.7-14: Plant S2 MOC 12 Core Average Axial Power Distribution



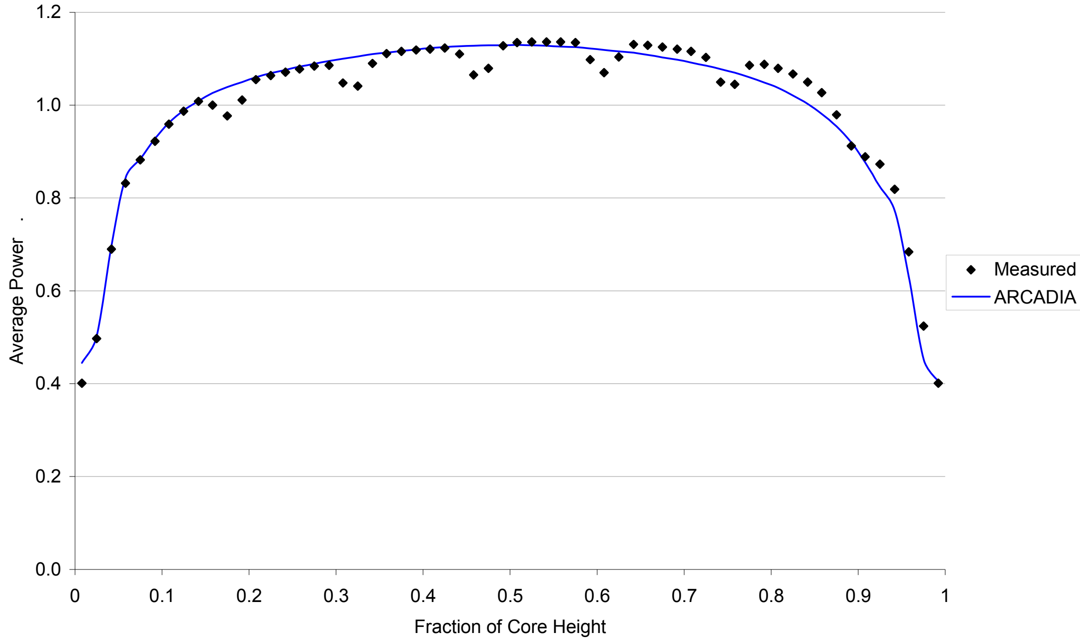
C - M Average Axial Power, RMS Difference *100 = 2.7

Figure S2 10.4.7-15: Plant S2 EOC 12 Core Average Axial Power Distribution



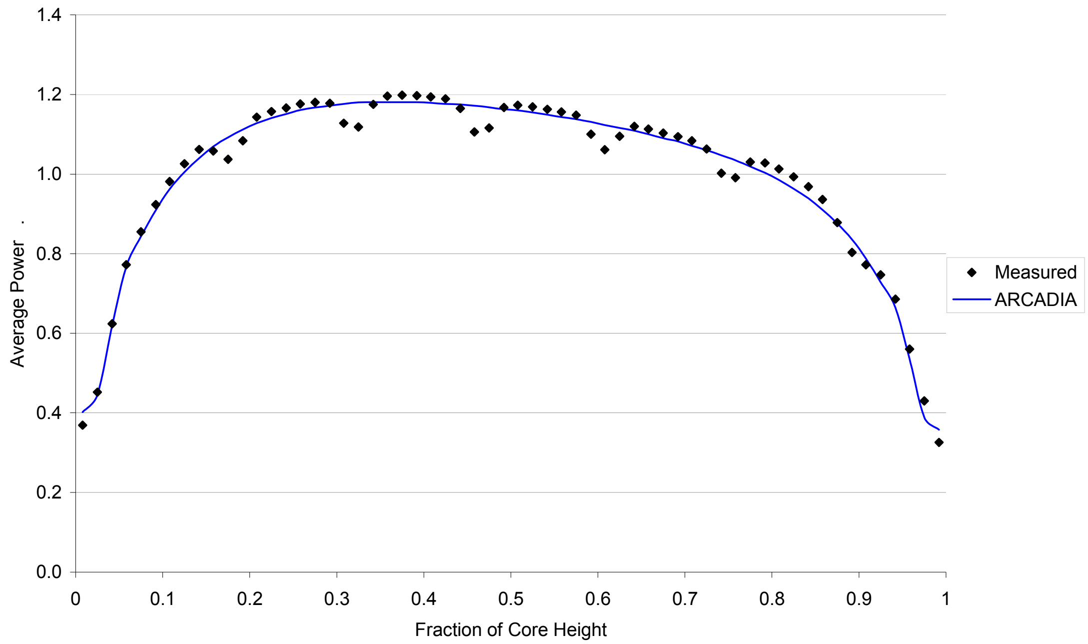
C - M Average Axial Power, RMS Difference *100 = 3.3

Figure S2 10.4.7-16: Plant S2 BOC 13 Core Average Axial Power Distribution



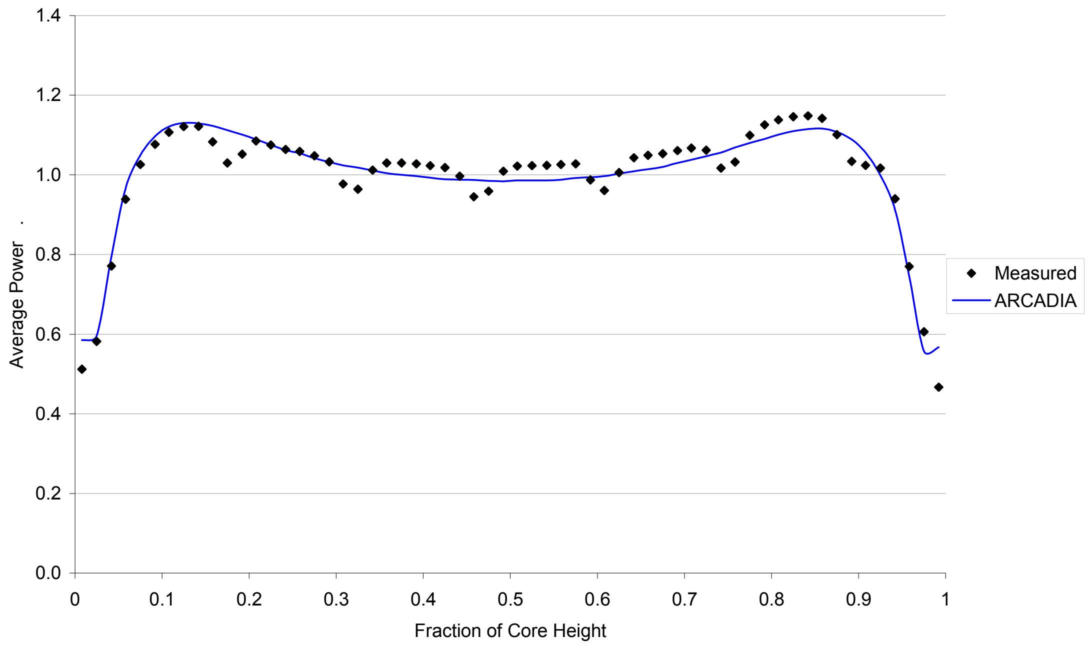
C - M Average Axial Power, RMS Difference *100 = 2.9

Figure S2 10.4.7-17: Plant S2 MOC 13 Core Average Axial Power Distribution



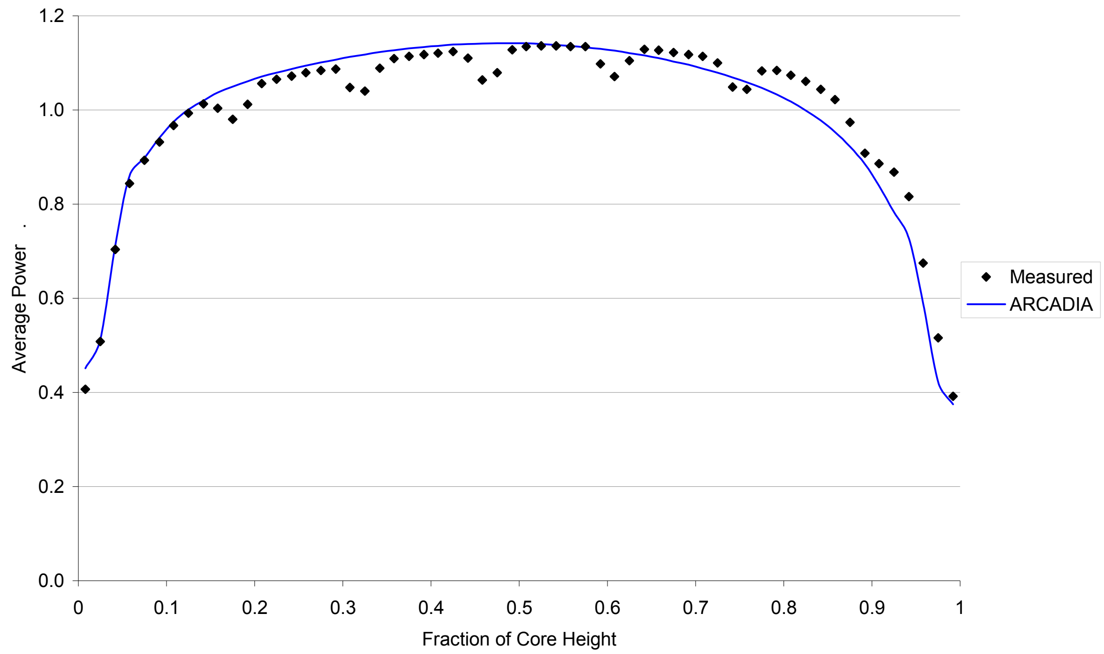
C - M Average Axial Power, RMS Difference *100 = 2.8

Figure S2 10.4.7-18: Plant S2 EOC 13 Core Average Axial Power Distribution



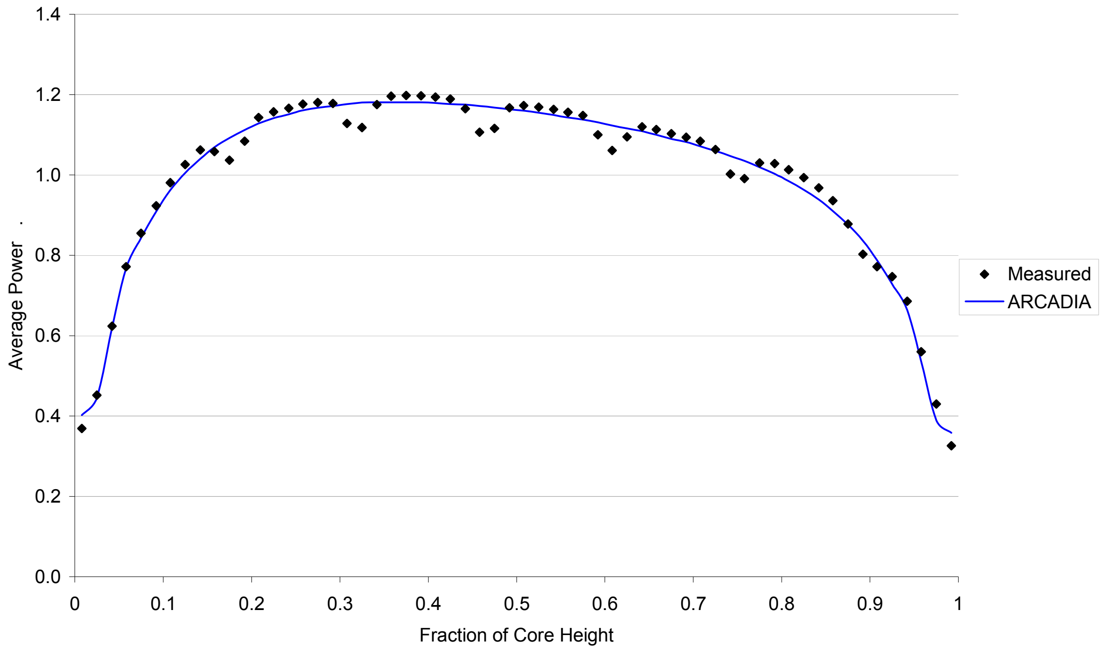
C - M Average Axial Power, RMS Difference *100 = 3.3

Figure S2 10.4.7-19: Plant S2 BOC 14 Core Average Axial Power Distribution



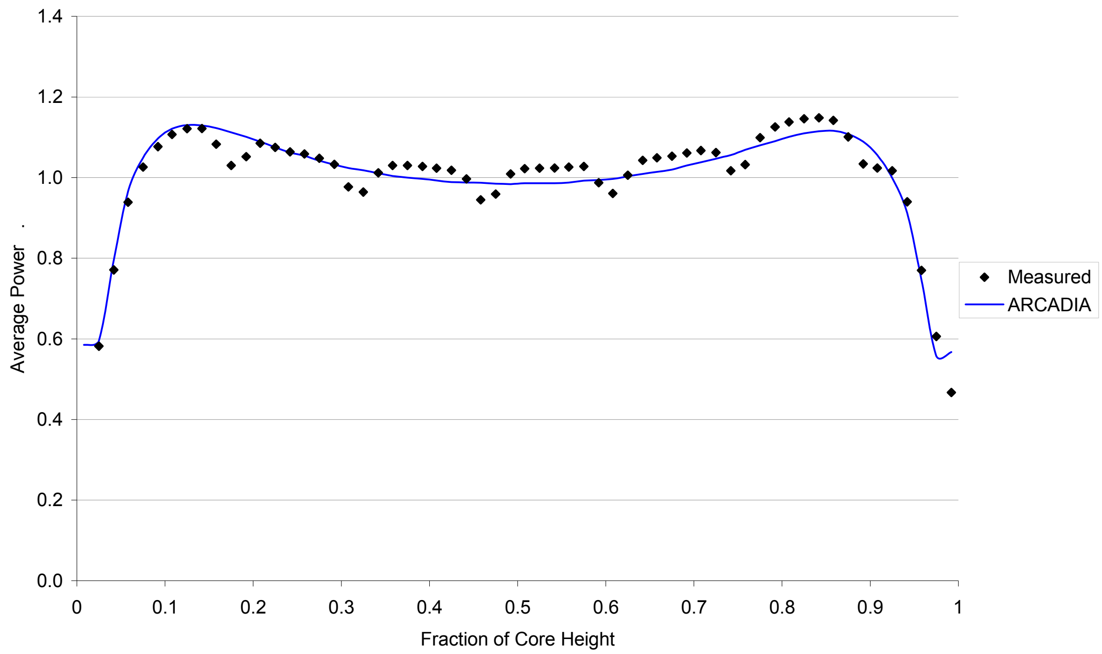
C - M Average Axial Power, RMS Difference *100 = 3.0

Figure S2 10.4.7-20: Plant S2 MOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 2.7

Figure S2 10.4.7-21: Plant S2 EOC 14 Core Average Axial Power Distribution



C - M Average Axial Power, RMS Difference *100 = 3.1

Appendix T1

Table T1 10.3.8-1: Plant T1 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 9-15

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
9	2157	2117	-40
10	2406	2349	-57 [a]
11	2295	2283	-12
12	2166	2151	-15
13	2176	2152	-24
14	2183	2160	-23
15	2213	2227	14

[a]Using the ±500 pcm criterion for Cycles 10 results in limits of ±74 ppm

Table T1 10.3.8-2: Plant T1 Cycle 9 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	889	865	-24	-2.7
6	817	841	24	3.0
5	1134	1092	-42	-3.7
Total	2840	2798	-42	-1.5

Table T1 10.3.8-3: Plant T1 Cycle 10 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	956	982	26	2.7
6	713	675	-38	-5.3
5	1400	1454	54	3.9
Total	3069	3111	41	1.4

Table T1 10.3.8-4: Plant T1 Cycle 11 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	1079	1016	-62	-5.8
6	808	883	75	9.3
5	1220	1165	-54	-4.4
Total	3106	3064	-41	-1.3

Table T1 10.3.8-5: Plant T1 Cycle 12 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	910	922	12	1.4
6	742	789	47	6.3
5	1263	1291	28	2.2
Total	2915	3002	87	3.0

Table T1 10.3.8-6: Plant T1 Cycle 13 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	934	947	13	1.4
6	868	901	33	3.8
5	1500	1538	39	2.6
Total	3302	3387	85	2.6

Table T1 10.3.8-7: Plant T1 Cycle 14 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	1001	983	-18	-1.8
6	825	892	67	8.1
5	1160	1181	21	1.8
Total	2986	3056	70	2.3

Table T1 10.3.8-8: Plant T1 Cycle 15 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
7	976	966	-10	-1.1
6	764	803	39	5.1
5	-	-	-	-
Total	1740	1769	29	1.7

Table T1 10.3.8-9: Plant T1 Summary of Total Bank Worth

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
9	2840	2798	-42	-1.5
10	3069	3111	41	1.4
11	3106	3064	-41	-1.3
12	2915	3002	87	3.0
13	3302	3387	85	2.6
14	2986	3056	70	2.3
15	1740	1769	29	1.7

Table T1 10.3.8-10: Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 9-15

Cycle	Measured (pcm/°F)	Calculated (pcm/°F)	Difference C-M (pcm/°F)
9	3.13	3.72	0.59
10	2.13	3.25	1.12
11	0.35	1.53	1.18
12	-1.43	0.00	1.43
13	-0.85	-0.20	0.65
14	-0.70	-0.10	0.60
15	0.14	0.91	0.77

Figure T1 10.2.1-6: Plant T1 Fuel Assembly Guide Tube Configuration

3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	1	3	3	3	1	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	1	3	3	3	3	3	3	3	1	3	3	3
3	3	3	3	3	1	3	3	3	1	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

- 1 Guide tube
- 2 Guide tube with instrument
- 3 UO_2 Rod

Figure T1 10.4.8-1: Plant T1 Cycle 9 Critical Boron Concentration vs. Burnup

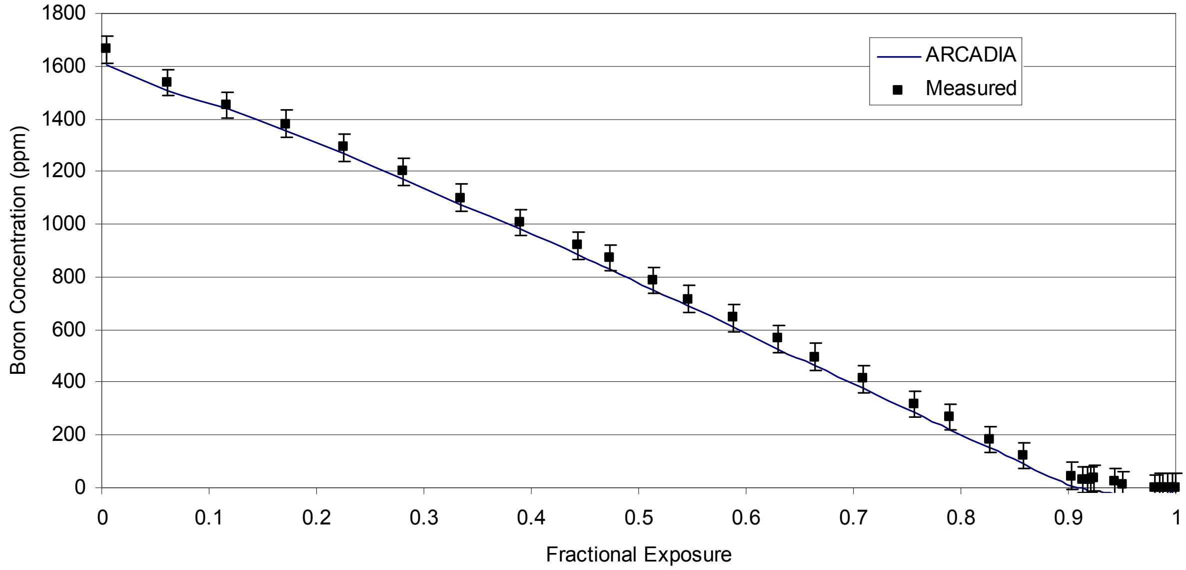


Figure T1 10.4.8-2: Plant T1 Cycle 10 Critical Boron Concentration vs. Burnup

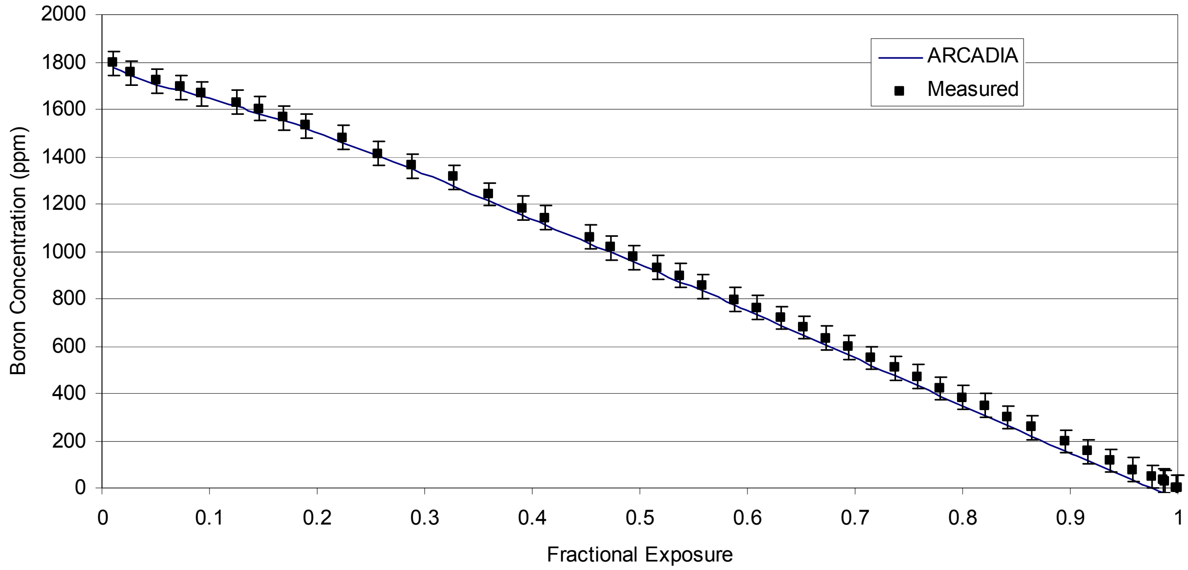


Figure T1 10.4.8-3: Plant T1 Cycle 11 Critical Boron Concentration vs. Burnup

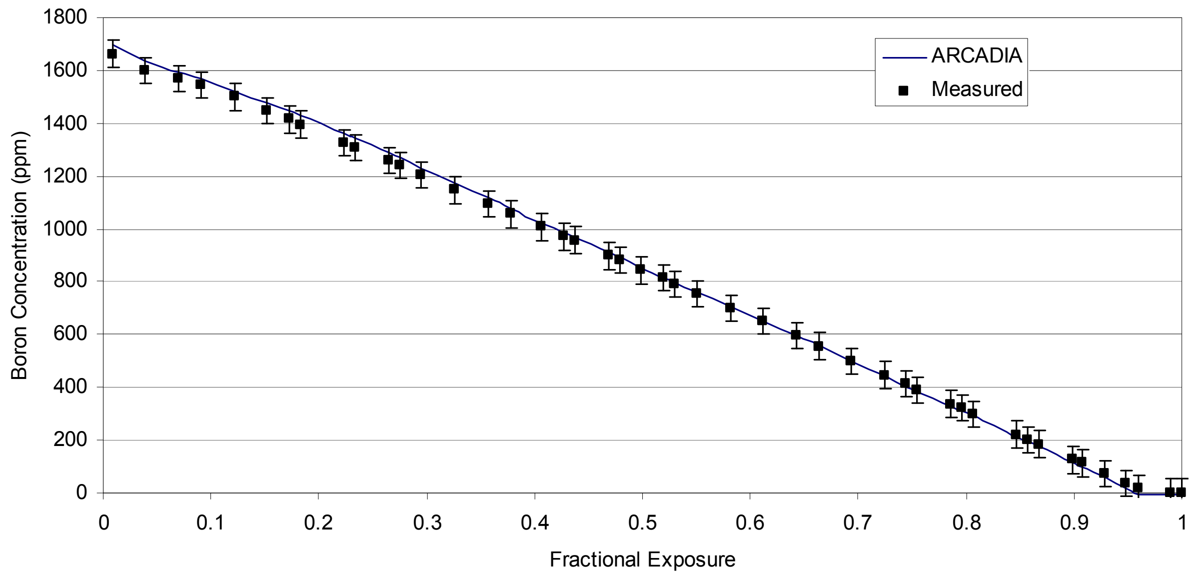


Figure T1 10.4.8-4: Plant T1 Cycle 12 Critical Boron Concentration vs. Burnup

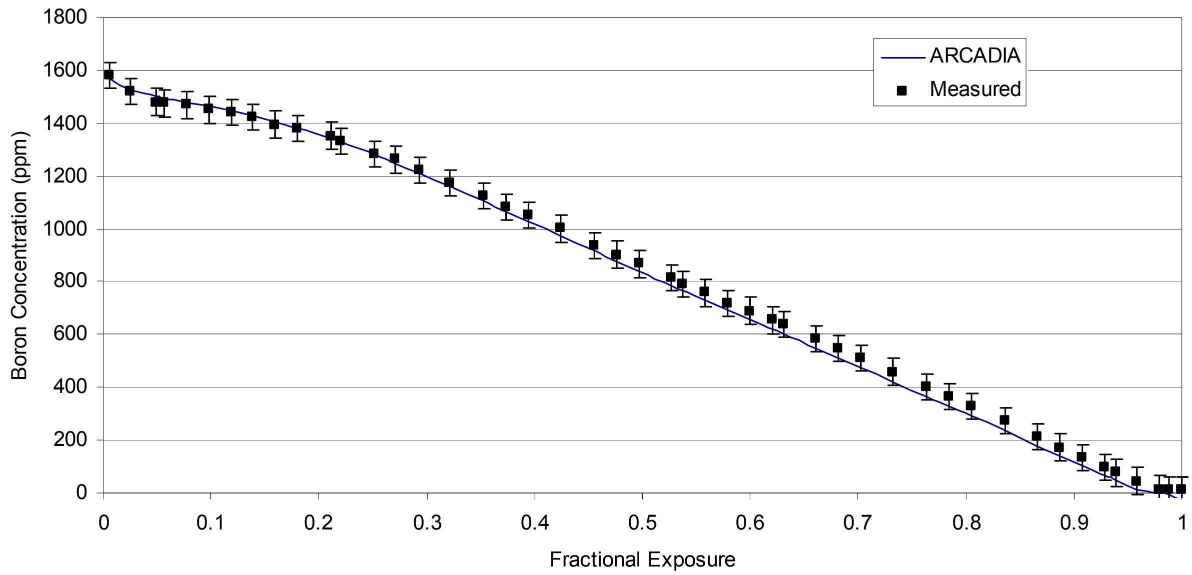


Figure T1 10.4.8-5: Plant T1 Cycle 13 Critical Boron Concentration vs. Burnup

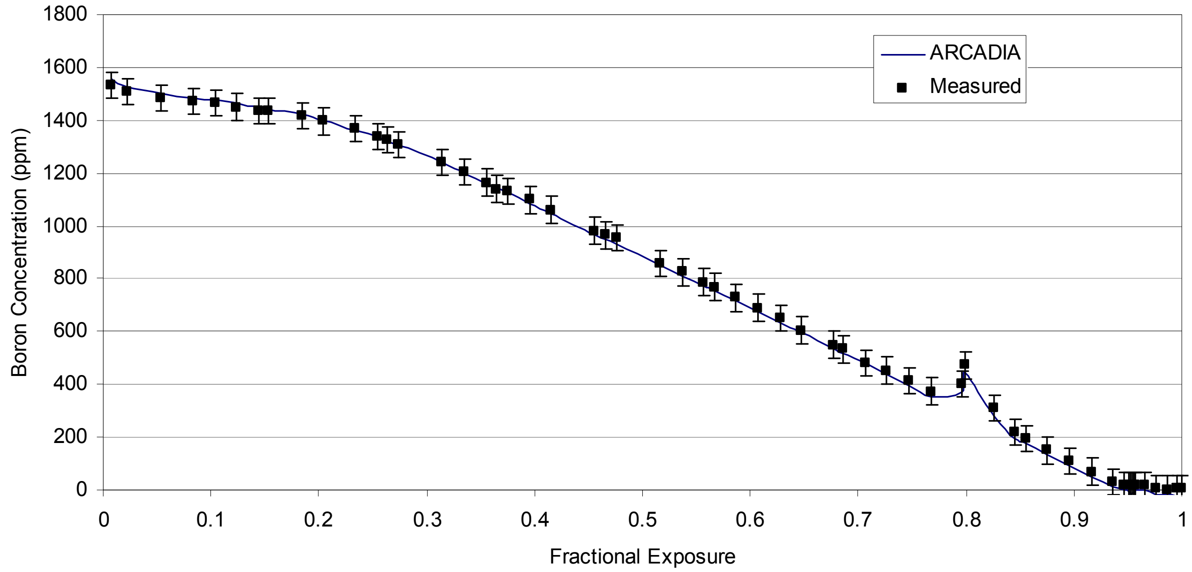


Figure T1 10.4.8-6: Plant T1 Cycle 14 Critical Boron Concentration vs. Burnup

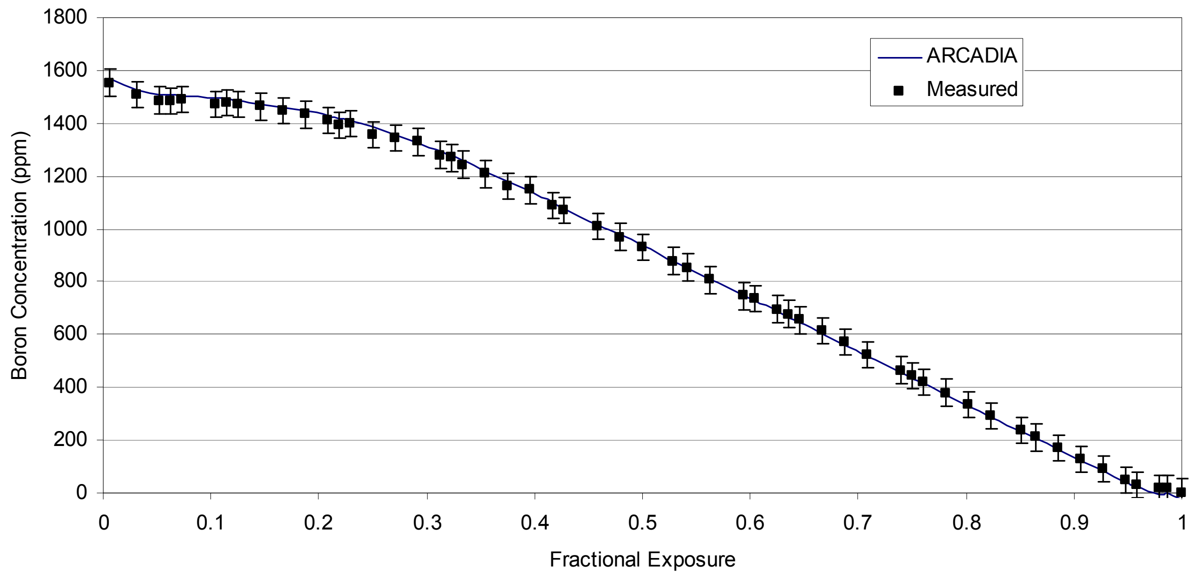


Figure T1 10.4.8-7: Plant T1 Cycle 15 Critical Boron Concentration vs. Burnup

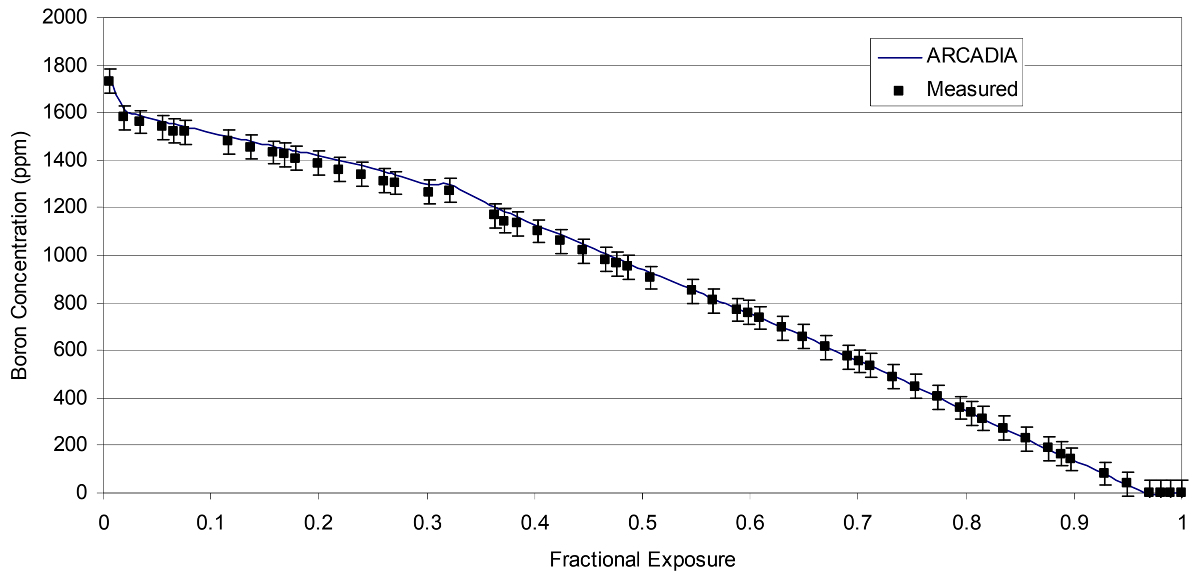


Figure T1 10.4.8-8: Plant T1 BOC 9 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.264 0.268 -0.3	0.274 0.276 -0.2	0.249 0.249 0.0	0.275 0.272 0.2	0.265 0.263 0.2					
B				0.385 0.389 -0.5	0.892 0.905 -1.2	1.067 1.083 -1.5	0.961 0.967 -0.6	0.784 0.785 -0.1	0.964 0.953 1.0	1.070 1.062 0.8	0.894 0.888 0.6	0.386 0.384 0.2			
C			0.489 0.494 -0.4	1.066 1.078 -1.2	1.079 1.094 -1.6	1.206 1.233 -2.7	1.100 1.103 -0.4	1.212 1.201 1.1	1.104 1.079 2.5	1.211 1.205 0.6	1.081 1.075 0.6	1.067 1.065 0.2	0.490 0.494 -0.3		
D		0.384 0.388 -0.3	1.064 1.073 -0.9	1.120 1.129 -0.9	1.234 1.247 -1.3	1.104 1.113 -0.9	1.267 1.262 0.5	1.144 1.125 1.9	1.279 1.246 3.3	1.110 1.094 1.6	1.236 1.226 1.1	1.122 1.121 0.1	1.068 1.081 -1.3	0.385 0.406 -2.1	
E		0.892 0.900 -0.8	1.077 1.086 -0.9	1.234 1.238 -0.4	1.176 1.181 -0.5	1.289 1.292 -0.3	1.189 1.174 1.5	1.220 1.191 2.9	1.211 1.153 5.8	1.297 1.266 3.1	1.177 1.160 1.7	1.235 1.233 0.2	1.080 1.096 -1.6	0.893 0.914 -2.1	
F	0.265 0.268 -0.4	1.068 1.080 -1.2	1.208 1.224 -1.6	1.108 1.114 -0.5	1.295 1.298 -0.2	1.236 1.246 -1.0	1.308 1.321 -1.3	1.287 1.264 2.3	1.326 1.293 3.4	1.237 1.212 2.4	1.289 1.273 1.7	1.104 1.097 0.8	1.206 1.241 -3.4	1.068 1.093 -2.5	0.265 0.271 -0.6
G	0.274 0.281 -0.6	0.962 0.974 -1.2	1.102 1.108 -0.7	1.277 1.275 0.1	1.210 1.196 1.3	1.325 1.351 -2.5	1.335 1.342 -0.7	1.316 1.307 0.9	1.334 1.309 2.5	1.307 1.289 1.8	1.188 1.176 1.3	1.267 1.266 0.1	1.099 1.104 -0.5	0.961 0.978 -1.7	0.274 0.279 -0.5
H	0.249 0.268 -1.9	0.783 0.792 -0.9	1.210 1.213 -0.3	1.142 1.137 0.5	1.218 1.212 0.7	1.284 1.283 0.1	1.311 1.311 0.1	1.085 1.089 -0.4	1.309 1.315 -0.5	1.284 1.275 0.9	1.219 1.212 0.7	1.143 1.155 -1.1	1.211 1.257 -4.6	0.783 0.804 -2.0	0.249 0.255 -0.6
K	0.274 0.279 -0.6	0.960 0.968 -0.8	1.098 1.097 0.2	1.266 1.252 1.4	1.187 1.152 3.6	1.305 1.284 2.1	1.329 1.315 1.4	1.304 1.294 1.0	1.329 1.319 1.0	1.323 1.309 1.5	1.209 1.191 1.9	1.277 1.291 -1.4	1.102 1.125 -2.3	0.962 0.982 -2.0	0.274 0.280 -0.6
L	0.264 0.268 -0.4	1.067 1.079 -1.2	1.205 1.203 0.2	1.103 1.093 1.0	1.287 1.263 2.4	1.234 1.201 3.3	1.322 1.301 2.1	1.282 1.263 1.8	1.304 1.285 1.9	1.234 1.214 2.0	1.295 1.287 0.7	1.108 1.115 -0.7	1.208 1.227 -1.9	1.068 1.087 -1.9	0.265 0.269 -0.5
M		0.892 0.890 0.2	1.078 1.063 1.5	1.232 1.224 0.9	1.175 1.162 1.3	1.294 1.278 1.6	1.208 1.190 1.8	1.217 1.196 2.1	1.187 1.159 2.8	1.287 1.246 4.1	1.175 1.164 1.2	1.234 1.236 -0.2	1.077 1.088 -1.0	0.892 0.907 -1.5	
N		0.385 0.383 0.1	1.066 1.061 0.5	1.119 1.123 -0.4	1.233 1.229 0.4	1.107 1.110 -0.2	1.276 1.270 0.5	1.142 1.123 1.9	1.265 1.253 1.3	1.103 1.094 0.8	1.233 1.230 0.3	1.120 1.122 -0.2	1.064 1.070 -0.6	0.384 0.388 -0.4	
O			0.489 0.487 0.2	1.064 1.062 0.2	1.077 1.068 0.9	1.207 1.240 -3.3	1.101 1.114 -1.3	1.210 1.213 -0.3	1.098 1.102 -0.4	1.205 1.219 -1.4	1.078 1.084 -0.6	1.066 1.069 -0.3	0.489 0.491 -0.2		
P				0.384 0.386 -0.2	0.891 0.904 -1.2	1.067 1.110 -4.3	0.961 0.987 -2.6	0.783 0.794 -1.1	0.960 0.974 -1.4	1.067 1.087 -2.1	0.892 0.902 -1.0	0.385 0.387 -0.2			
R						0.264 0.277 -1.2	0.274 0.294 -2.0	0.249 0.257 -0.8	0.274 0.283 -0.9	0.264 0.293 -2.9					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.6

Figure T1 10.4.8-9: Plant T1 MOC 9 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.307 0.306 0.1	0.337 0.333 0.3	0.318 0.317 0.1	0.337 0.335 0.1	0.307 0.306 0.1					
B				0.394 0.394 0.0	0.857 0.857 0.0	1.038 1.037 0.1	1.041 1.027 1.3	0.845 0.843 0.2	1.041 1.038 0.3	1.038 1.035 0.3	0.857 0.856 0.1	0.395 0.394 0.0			
C			0.479 0.479 0.0	0.975 0.976 -0.1	1.024 1.026 -0.2	1.267 1.278 -1.1	1.094 1.090 0.3	1.273 1.267 0.5	1.095 1.089 0.6	1.268 1.264 0.4	1.024 1.023 0.0	0.974 0.976 -0.2	0.479 0.479 0.1		
D		0.394 0.392 0.1	0.973 0.973 0.1	1.043 1.044 -0.1	1.289 1.287 0.2	1.104 1.105 -0.1	1.316 1.312 0.4	1.096 1.088 0.8	1.321 1.310 1.1	1.106 1.110 -0.4	1.289 1.293 -0.4	1.043 1.049 -0.6	0.975 0.985 -1.1	0.394 0.410 -1.5	
E		0.856 0.852 0.5	1.022 1.021 0.2	1.289 1.292 -0.3	1.154 1.155 -0.1	1.351 1.351 -0.1	1.128 1.122 0.6	1.128 1.111 1.7	1.139 1.110 2.9	1.354 1.345 0.9	1.155 1.158 -0.3	1.289 1.297 -0.8	1.024 1.035 -1.1	0.857 0.870 -1.3	
F	0.307 0.304 0.3	1.038 1.028 1.0	1.268 1.263 0.5	1.106 1.107 -0.1	1.354 1.359 -0.5	1.178 1.183 -0.5	1.322 1.323 -0.1	1.180 1.156 2.4	1.332 1.313 2.0	1.178 1.169 0.9	1.351 1.348 0.3	1.104 1.109 -0.5	1.267 1.285 -1.7	1.038 1.050 -1.2	0.307 0.310 -0.3
G	0.337 0.335 0.2	1.041 1.021 2.0	1.095 1.087 0.7	1.321 1.321 0.0	1.139 1.147 -0.8	1.332 1.350 -1.8	1.238 1.246 -0.8	1.336 1.338 -0.3	1.237 1.229 0.8	1.322 1.314 0.8	1.128 1.119 0.9	1.316 1.315 0.1	1.094 1.089 0.5	1.041 1.047 -0.6	0.337 0.339 -0.2
H	0.319 0.334 -1.5	0.845 0.845 0.1	1.273 1.269 0.4	1.096 1.092 0.3	1.128 1.124 0.4	1.180 1.186 -0.6	1.333 1.348 -1.5	1.068 1.100 -3.3	1.332 1.337 -0.5	1.180 1.177 0.3	1.128 1.123 0.4	1.096 1.100 -0.4	1.273 1.299 -2.6	0.845 0.854 -0.9	0.319 0.321 -0.3
K	0.337 0.343 -0.6	1.041 1.050 -0.8	1.094 1.089 0.5	1.316 1.309 0.8	1.128 1.116 1.3	1.322 1.321 0.1	1.236 1.241 -0.6	1.330 1.341 -1.1	1.236 1.237 -0.1	1.332 1.326 0.6	1.139 1.130 0.9	1.321 1.316 0.5	1.095 1.101 -0.6	1.041 1.049 -0.7	0.337 0.339 -0.2
L	0.307 0.314 -0.7	1.038 1.063 -2.5	1.268 1.253 1.5	1.105 1.098 0.6	1.351 1.344 0.7	1.178 1.176 0.2	1.332 1.331 0.1	1.179 1.179 0.0	1.322 1.318 0.4	1.179 1.167 1.2	1.354 1.352 0.2	1.106 1.104 0.2	1.268 1.270 -0.2	1.038 1.043 -0.5	0.307 0.308 -0.1
M		0.857 0.868 -1.1	1.024 1.027 -0.4	1.289 1.290 -0.1	1.155 1.151 0.4	1.354 1.349 0.6	1.139 1.131 0.8	1.128 1.121 0.6	1.128 1.125 0.4	1.351 1.312 3.9	1.155 1.144 1.1	1.289 1.286 0.2	1.023 1.024 -0.1	0.856 0.862 -0.6	
N		0.394 0.398 -0.3	0.975 0.980 -0.6	1.043 1.052 -0.9	1.289 1.286 0.3	1.106 1.100 0.7	1.321 1.312 0.9	1.096 1.082 1.4	1.317 1.306 1.1	1.105 1.095 1.0	1.289 1.285 0.4	1.043 1.045 -0.2	0.974 0.976 -0.3	0.394 0.395 -0.1	
O			0.479 0.480 -0.1	0.974 0.973 0.0	1.023 1.012 1.1	1.268 1.257 1.1	1.095 1.090 0.5	1.273 1.268 0.5	1.094 1.093 0.1	1.268 1.275 -0.7	1.024 1.028 -0.4	0.975 0.984 -0.9	0.479 0.482 -0.2		
P				0.394 0.394 0.0	0.857 0.857 0.0	1.038 1.049 -1.1	1.041 1.048 -0.6	0.845 0.848 -0.2	1.041 1.048 -0.7	1.038 1.051 -1.3	0.857 0.864 -0.7	0.394 0.398 -0.3			
R						0.307 0.312 -0.5	0.337 0.347 -1.1	0.319 0.323 -0.4	0.337 0.344 -0.7	0.307 0.330 -2.3					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 0.9

Figure T1 10.4.8-10: Plant T1 EOC 9 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.378 0.378 0.0	0.415 0.412 0.3	0.401 0.401 0.0	0.415 0.414 0.0	0.378 0.375 0.2					
B				0.469 0.473 -0.4	0.927 0.933 -0.6	1.076 1.079 -0.3	1.091 1.075 1.5	0.898 0.902 -0.5	1.090 1.090 0.0	1.075 1.066 0.9	0.926 0.917 0.9	0.469 0.463 0.6			
C			0.556 0.561 -0.5	1.027 1.037 -1.0	1.056 1.067 -1.1	1.295 1.315 -2.0	1.088 1.092 -0.5	1.244 1.249 -0.5	1.088 1.094 -0.6	1.295 1.275 1.9	1.056 1.044 1.2	1.026 1.011 1.5	0.556 0.535 2.1		
D		0.469 0.471 -0.2	1.026 1.035 -0.9	1.068 1.080 -1.2	1.309 1.318 -1.0	1.159 1.172 -1.3	1.278 1.288 -1.1	1.053 1.055 -0.2	1.279 1.276 0.4	1.159 1.157 0.2	1.308 1.303 0.5	1.068 1.059 0.9	1.027 1.015 1.1	0.469 0.471 -0.2	
E		0.926 0.927 -0.1	1.055 1.062 -0.7	1.308 1.331 -2.3	1.130 1.146 -1.6	1.299 1.318 -1.9	1.059 1.076 -1.7	1.048 1.045 0.4	1.064 1.048 1.7	1.299 1.292 0.8	1.130 1.135 -0.5	1.308 1.302 0.7	1.056 1.050 0.6	0.927 0.923 0.3	
F	0.378 0.376 0.2	1.075 1.068 0.7	1.295 1.295 0.0	1.159 1.173 -1.4	1.300 1.323 -2.4	1.083 1.100 -1.8	1.186 1.195 -0.8	1.052 1.033 1.8	1.192 1.174 1.8	1.083 1.071 1.2	1.299 1.287 1.1	1.159 1.146 1.3	1.295 1.290 0.5	1.076 1.070 0.5	0.378 0.376 0.2
G	0.415 0.413 0.2	1.091 1.068 2.3	1.088 1.086 0.1	1.279 1.295 -1.5	1.064 1.098 -3.3	1.192 1.222 -3.0	1.081 1.095 -1.3	1.166 1.168 -0.1	1.081 1.064 1.7	1.187 1.169 1.8	1.059 1.040 1.9	1.278 1.262 1.6	1.088 1.076 1.2	1.091 1.084 0.7	0.415 0.413 0.3
H	0.401 0.416 -1.5	0.898 0.899 -0.1	1.244 1.246 -0.2	1.054 1.060 -0.6	1.049 1.056 -0.7	1.052 1.067 -1.5	1.165 1.184 -1.8	0.949 0.976 -2.7	1.165 1.148 1.7	1.052 1.036 1.6	1.049 1.032 1.7	1.054 1.042 1.1	1.244 1.253 -0.9	0.898 0.895 0.3	0.401 0.399 0.2
K	0.415 0.423 -0.7	1.091 1.101 -1.0	1.088 1.088 -0.1	1.278 1.281 -0.3	1.059 1.059 0.0	1.187 1.197 -1.0	1.081 1.092 -1.1	1.164 1.173 -1.0	1.081 1.074 0.7	1.192 1.173 1.9	1.065 1.042 2.2	1.280 1.251 2.8	1.088 1.075 1.3	1.091 1.079 1.2	0.415 0.411 0.4
L	0.378 0.386 -0.8	1.076 1.100 -2.4	1.296 1.283 1.2	1.159 1.163 -0.4	1.299 1.306 -0.7	1.083 1.095 -1.2	1.192 1.200 -0.8	1.052 1.056 -0.4	1.187 1.182 0.5	1.083 1.062 2.1	1.300 1.278 2.2	1.159 1.137 2.2	1.295 1.270 2.4	1.075 1.058 1.7	0.378 0.372 0.6
M		0.927 0.947 -2.0	1.056 1.078 -2.1	1.309 1.327 -1.9	1.130 1.140 -1.0	1.300 1.308 -0.8	1.065 1.068 -0.3	1.049 1.054 -0.5	1.059 1.064 -0.5	1.299 1.247 5.2	1.130 1.106 2.5	1.308 1.285 2.3	1.055 1.036 1.9	0.926 0.909 1.8	
N		0.469 0.479 -1.0	1.027 1.049 -2.3	1.068 1.096 -2.8	1.308 1.320 -1.2	1.159 1.162 -0.2	1.280 1.284 -0.4	1.054 1.061 -0.7	1.278 1.274 0.4	1.159 1.145 1.5	1.309 1.293 1.6	1.068 1.055 1.2	1.026 1.012 1.4	0.469 0.461 0.8	
O			0.556 0.566 -1.0	1.026 1.039 -1.3	1.055 1.054 0.1	1.295 1.282 1.3	1.088 1.089 -0.1	1.244 1.250 -0.6	1.088 1.092 -0.4	1.296 1.302 -0.6	1.056 1.054 0.2	1.027 1.024 0.2	0.556 0.551 0.5		
P				0.469 0.473 -0.5	0.926 0.932 -0.6	1.075 1.088 -1.3	1.091 1.100 -0.9	0.898 0.905 -0.7	1.091 1.100 -0.9	1.076 1.086 -1.1	0.927 0.930 -0.3	0.469 0.469 0.0			
R						0.378 0.383 -0.6	0.415 0.424 -0.9	0.401 0.406 -0.5	0.415 0.423 -0.7	0.378 0.396 -1.8					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.3

Figure T1 10.4.8-11: Plant T1 BOC 10 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.260 0.260 0.0	0.284 0.281 0.3	0.268 0.265 0.3	0.286 0.282 0.4	0.261 0.255 0.6					
B				0.412 0.418 -0.6	0.992 1.002 -1.0	1.160 1.166 -0.5	1.143 1.128 1.5	0.883 0.875 0.8	1.150 1.132 1.8	1.162 1.133 2.9	0.991 0.963 2.7	0.411 0.398 1.2			
C			0.494 0.503 -0.9	1.155 1.176 -2.0	1.060 1.078 -1.7	1.289 1.311 -2.2	1.147 1.143 0.4	1.238 1.225 1.3	1.145 1.131 1.4	1.288 1.250 3.8	1.059 1.028 3.1	1.154 1.118 3.6	0.494 0.475 2.0		
D		0.410 0.417 -0.7	1.154 1.176 -2.2	1.146 1.170 -2.4	1.319 1.343 -2.3	1.044 1.053 -0.9	1.256 1.246 0.9	1.113 1.093 2.0	1.243 1.216 2.7	1.040 1.022 1.8	1.318 1.279 3.9	1.147 1.113 3.3	1.156 1.122 3.4	0.412 0.396 1.6	
E		0.991 1.004 -1.3	1.059 1.079 -2.0	1.317 1.355 -3.8	1.139 1.159 -1.9	1.308 1.315 -0.7	1.085 1.067 1.8	1.079 1.043 3.6	1.074 1.031 4.2	1.305 1.263 4.2	1.140 1.093 4.7	1.320 1.286 3.4	1.061 1.040 2.0	0.992 0.973 1.9	
F	0.261 0.262 -0.2	1.162 1.170 -0.8	1.287 1.305 -1.8	1.040 1.061 -2.1	1.304 1.326 -2.2	1.116 1.128 -1.2	1.252 1.246 0.6	1.031 0.970 6.1	1.249 1.199 5.0	1.117 1.085 3.2	1.309 1.279 3.1	1.044 1.033 1.1	1.290 1.284 0.6	1.161 1.147 1.4	0.260 0.257 0.3
G	0.286 0.287 -0.1	1.151 1.144 0.6	1.146 1.158 -1.3	1.243 1.264 -2.2	1.074 1.094 -2.1	1.248 1.280 -3.2	0.994 0.994 0.0	1.185 1.154 3.2	0.998 0.965 3.3	1.255 1.230 2.5	1.087 1.076 1.1	1.257 1.242 1.5	1.148 1.139 0.9	1.144 1.129 1.5	0.285 0.281 0.4
H	0.268 0.279 -1.2	0.884 0.897 -1.4	1.238 1.259 -2.1	1.113 1.135 -2.2	1.079 1.108 -2.8	1.032 1.050 -1.8	1.187 1.191 -0.4	0.878 0.868 1.0	1.197 1.206 -0.9	1.035 1.026 0.9	1.081 1.066 1.5	1.115 1.095 2.0	1.239 1.193 4.6	0.884 0.864 2.0	0.268 0.263 0.5
K	0.284 0.294 -1.0	1.144 1.177 -3.3	1.147 1.172 -2.5	1.256 1.281 -2.4	1.086 1.104 -1.8	1.254 1.272 -1.8	1.001 1.007 -0.6	1.198 1.197 0.1	1.004 1.003 0.1	1.254 1.243 1.0	1.076 1.057 2.0	1.245 1.236 0.9	1.147 1.127 2.0	1.152 1.133 1.8	0.286 0.282 0.4
L	0.260 0.271 -1.1	1.161 1.213 -5.2	1.290 1.319 -2.9	1.044 1.065 -2.0	1.310 1.332 -2.2	1.118 1.136 -1.8	1.252 1.263 -1.1	1.036 1.038 -0.2	1.258 1.255 0.3	1.119 1.114 0.5	1.307 1.319 -1.2	1.041 1.039 0.2	1.289 1.278 1.1	1.163 1.151 1.1	0.261 0.258 0.3
M		0.992 1.017 -2.5	1.061 1.068 -0.7	1.320 1.342 -2.1	1.140 1.158 -1.8	1.306 1.324 -1.8	1.076 1.085 -0.9	1.081 1.085 -0.4	1.088 1.082 0.6	1.311 1.289 2.1	1.141 1.137 0.4	1.319 1.314 0.5	1.060 1.054 0.6	0.992 0.989 0.3	
N		0.412 0.420 -0.8	1.156 1.174 -1.8	1.147 1.173 -2.6	1.319 1.340 -2.1	1.041 1.057 -1.6	1.244 1.260 -1.6	1.114 1.124 -1.0	1.257 1.265 -0.8	1.045 1.044 0.1	1.321 1.317 0.3	1.148 1.142 0.6	1.155 1.148 0.7	0.411 0.409 0.2	
O			0.494 0.502 -0.8	1.155 1.174 -1.9	1.060 1.071 -1.1	1.289 1.312 -2.3	1.147 1.166 -2.0	1.239 1.255 -1.7	1.148 1.159 -1.1	1.290 1.298 -0.8	1.061 1.061 0.1	1.156 1.146 1.0	0.495 0.491 0.4		
P				0.411 0.419 -0.8	0.992 1.015 -2.3	1.163 1.206 -4.3	1.152 1.182 -3.0	0.884 0.900 -1.6	1.144 1.159 -1.4	1.161 1.173 -1.2	0.992 0.996 -0.3	0.412 0.411 0.1			
R						0.261 0.271 -1.0	0.287 0.300 -1.3	0.268 0.274 -0.6	0.285 0.290 -0.6	0.260 0.273 -1.3					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.0

Figure T1 10.4.8-12: Plant T1 MOC 10 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.271 0.269 0.2	0.315 0.310 0.5	0.307 0.308 -0.1	0.316 0.319 -0.3	0.272 0.273 -0.2					
B				0.388 0.387 0.2	0.890 0.887 0.3	1.060 1.055 0.5	1.120 1.096 2.4	0.904 0.912 -0.8	1.125 1.139 -1.4	1.061 1.068 -0.8	0.889 0.895 -0.6	0.387 0.390 -0.2			
C			0.451 0.448 0.3	0.993 0.990 0.3	0.973 0.971 0.2	1.324 1.337 -1.3	1.143 1.143 0.0	1.343 1.355 -1.1	1.142 1.166 -2.4	1.323 1.328 -0.4	0.973 0.979 -0.6	0.993 1.000 -0.7	0.451 0.450 0.1		
D		0.387 0.383 0.5	0.993 0.986 0.6	1.023 1.018 0.4	1.313 1.301 1.2	1.067 1.067 0.0	1.370 1.372 -0.2	1.142 1.146 -0.4	1.361 1.374 -1.3	1.064 1.088 -2.3	1.312 1.329 -1.7	1.022 1.033 -1.1	0.993 1.000 -0.7	0.388 0.384 0.4	
E		0.889 0.875 1.4	0.973 0.964 0.9	1.312 1.315 -0.3	1.110 1.108 0.2	1.373 1.373 0.0	1.098 1.100 -0.2	1.090 1.080 1.0	1.091 1.083 0.9	1.371 1.381 -1.0	1.110 1.121 -1.1	1.313 1.331 -1.8	0.973 0.985 -1.2	0.890 0.898 -0.8	
F	0.272 0.264 0.8	1.061 1.035 2.5	1.323 1.306 1.8	1.065 1.061 0.3	1.371 1.375 -0.4	1.124 1.121 0.4	1.343 1.324 1.9	1.062 1.024 3.8	1.341 1.326 1.5	1.125 1.128 -0.3	1.373 1.391 -1.8	1.066 1.090 -2.3	1.324 1.351 -2.7	1.060 1.074 -1.4	0.271 0.274 -0.3
G	0.316 0.306 1.0	1.125 1.078 4.6	1.142 1.123 1.9	1.361 1.359 0.2	1.091 1.108 -1.7	1.341 1.345 -0.4	1.052 1.045 0.7	1.324 1.309 1.5	1.054 1.047 0.7	1.344 1.351 -0.7	1.099 1.117 -1.9	1.370 1.391 -2.1	1.143 1.168 -2.5	1.120 1.131 -1.1	0.315 0.317 -0.2
H	0.307 0.308 -0.1	0.905 0.888 1.6	1.343 1.328 1.5	1.142 1.137 0.5	1.090 1.094 -0.4	1.062 1.062 0.0	1.325 1.323 0.2	0.980 0.982 -0.2	1.332 1.343 -1.1	1.063 1.068 -0.5	1.090 1.097 -0.6	1.142 1.141 0.0	1.343 1.302 4.1	0.904 0.896 0.9	0.307 0.305 0.2
K	0.315 0.314 0.1	1.120 1.113 0.6	1.143 1.131 1.2	1.370 1.359 1.0	1.098 1.088 1.1	1.344 1.340 0.4	1.056 1.054 0.2	1.333 1.335 -0.2	1.058 1.061 -0.3	1.343 1.346 -0.3	1.092 1.094 -0.2	1.361 1.372 -1.1	1.142 1.137 0.5	1.125 1.122 0.3	0.316 0.315 0.1
L	0.271 0.272 -0.1	1.060 1.067 -0.8	1.324 1.306 1.8	1.066 1.058 0.9	1.373 1.366 0.7	1.125 1.122 0.3	1.343 1.339 0.4	1.064 1.065 -0.1	1.345 1.351 -0.5	1.125 1.120 0.5	1.371 1.386 -1.5	1.064 1.072 -0.8	1.323 1.338 -1.5	1.060 1.065 -0.5	0.272 0.272 0.0
M		0.890 0.888 0.2	0.973 0.962 1.1	1.313 1.309 0.3	1.110 1.105 0.5	1.371 1.365 0.6	1.091 1.081 1.1	1.090 1.096 -0.5	1.099 1.112 -1.3	1.373 1.334 4.0	1.110 1.104 0.6	1.312 1.315 -0.4	0.972 0.977 -0.4	0.889 0.893 -0.4	
N		0.388 0.388 0.1	0.993 0.993 0.0	1.022 1.032 -1.0	1.312 1.312 0.1	1.064 1.059 0.5	1.361 1.361 0.0	1.142 1.159 -1.7	1.370 1.372 -0.3	1.066 1.060 0.7	1.313 1.311 0.2	1.022 1.024 -0.2	0.992 0.996 -0.3	0.387 0.388 -0.1	
O			0.451 0.451 0.0	0.993 0.995 -0.2	0.973 0.967 0.5	1.323 1.308 1.6	1.142 1.139 0.3	1.343 1.351 -0.8	1.143 1.148 -0.5	1.324 1.334 -1.0	0.973 0.975 -0.2	0.993 0.994 -0.1	0.451 0.451 0.0		
P				0.387 0.387 0.0	0.889 0.887 0.2	1.060 1.060 0.0	1.125 1.124 0.0	0.904 0.907 -0.3	1.120 1.127 -0.7	1.059 1.068 -0.8	0.889 0.894 -0.4	0.388 0.389 -0.1			
R						0.272 0.271 0.1	0.316 0.314 0.2	0.307 0.307 0.0	0.315 0.317 -0.2	0.271 0.280 -0.8					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.1

Figure T1 10.4.8-13: Plant T1 EOC 10 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*10(

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.332 0.327 0.5	0.382 0.373 0.9	0.379 0.379 0.0	0.383 0.384 -0.1	0.332 0.330 0.2					
B				0.467 0.463 0.4	0.952 0.943 0.9	1.063 1.051 1.2	1.114 1.076 3.8	0.929 0.936 -0.7	1.117 1.124 -0.7	1.064 1.055 0.9	0.952 0.942 0.9	0.466 0.461 0.5			
C			0.532 0.528 0.3	1.038 1.031 0.7	0.991 0.985 0.6	1.296 1.304 -0.8	1.099 1.095 0.4	1.295 1.303 -0.8	1.100 1.122 -2.2	1.296 1.269 2.7	0.991 0.980 1.0	1.038 1.025 1.3	0.532 0.516 1.6		
D		0.466 0.463 0.3	1.038 1.032 0.6	1.029 1.023 0.7	1.294 1.273 2.2	1.044 1.041 0.3	1.311 1.312 -0.1	1.088 1.090 -0.2	1.307 1.316 -0.8	1.044 1.059 -1.6	1.294 1.296 -0.2	1.029 1.024 0.6	1.038 1.021 1.7	0.467 0.448 1.9	
E		0.952 0.944 0.8	0.991 0.988 0.3	1.294 1.297 -0.3	1.080 1.078 0.1	1.318 1.317 0.1	1.061 1.070 -0.8	1.061 1.052 0.9	1.057 1.046 1.1	1.318 1.321 -0.3	1.079 1.087 -0.8	1.294 1.294 0.0	0.991 0.983 0.8	0.952 0.938 1.4	
F	0.332 0.328 0.4	1.064 1.050 1.4	1.296 1.291 0.5	1.044 1.049 -0.6	1.318 1.330 -1.2	1.084 1.078 0.6	1.306 1.272 3.4	1.044 1.010 3.4	1.305 1.290 1.5	1.084 1.084 0.0	1.318 1.327 -0.9	1.044 1.052 -0.8	1.295 1.288 0.7	1.063 1.054 1.0	0.332 0.328 0.3
G	0.383 0.379 0.5	1.117 1.085 3.2	1.100 1.097 0.2	1.307 1.325 -1.7	1.057 1.099 -4.2	1.305 1.298 0.7	1.042 1.034 0.8	1.310 1.302 0.9	1.043 1.041 0.2	1.305 1.306 -0.1	1.061 1.076 -1.5	1.311 1.315 -0.5	1.099 1.117 -1.8	1.114 1.105 0.9	0.382 0.377 0.5
H	0.379 0.392 -1.3	0.929 0.932 -0.3	1.295 1.302 -0.8	1.088 1.101 -1.3	1.060 1.080 -2.0	1.044 1.052 -0.8	1.311 1.319 -0.8	0.992 1.011 -1.8	1.313 1.293 2.1	1.044 1.036 0.8	1.060 1.054 0.6	1.088 1.063 2.4	1.295 1.215 8.0	0.929 0.898 3.1	0.379 0.369 1.1
K	0.382 0.392 -1.0	1.114 1.135 -2.1	1.099 1.112 -1.2	1.311 1.327 -1.6	1.061 1.074 -1.3	1.305 1.321 -1.6	1.044 1.053 -1.0	1.314 1.323 -0.9	1.044 1.039 0.5	1.304 1.291 1.3	1.057 1.051 0.6	1.307 1.276 3.1	1.099 1.064 3.6	1.117 1.085 3.2	0.383 0.373 1.1
L	0.332 0.344 -1.3	1.063 1.106 -4.3	1.295 1.305 -0.9	1.044 1.061 -1.7	1.318 1.340 -2.3	1.084 1.108 -2.4	1.304 1.316 -1.2	1.044 1.053 -0.9	1.305 1.305 0.0	1.084 1.060 2.3	1.317 1.294 2.3	1.043 1.023 2.1	1.296 1.277 1.9	1.064 1.042 2.2	0.332 0.324 0.8
M		0.952 0.983 -3.1	0.991 1.016 -2.5	1.294 1.327 -3.3	1.079 1.103 -2.3	1.317 1.336 -1.9	1.057 1.057 0.0	1.060 1.077 -1.7	1.061 1.081 -2.1	1.317 1.242 7.5	1.079 1.047 3.2	1.294 1.266 2.8	0.991 0.972 1.9	0.952 0.933 1.9	
N		0.467 0.483 -1.6	1.038 1.072 -3.4	1.029 1.072 -4.3	1.294 1.328 -3.4	1.044 1.060 -1.7	1.307 1.328 -2.1	1.087 1.126 -3.9	1.311 1.302 0.8	1.044 1.022 2.2	1.294 1.268 2.6	1.029 1.010 2.0	1.038 1.018 1.9	0.466 0.457 0.9	
O			0.532 0.550 -1.8	1.038 1.073 -3.5	0.991 1.019 -2.8	1.296 1.303 -0.7	1.100 1.117 -1.8	1.295 1.319 -2.4	1.099 1.106 -0.6	1.295 1.297 -0.1	0.991 0.981 1.0	1.038 1.021 1.7	0.532 0.522 0.9		
P				0.466 0.481 -1.5	0.952 0.980 -2.8	1.064 1.097 -3.3	1.117 1.143 -2.6	0.929 0.947 -1.7	1.114 1.125 -1.1	1.063 1.069 -0.6	0.952 0.948 0.4	0.467 0.462 0.5			
R						0.332 0.344 -1.2	0.384 0.399 -1.6	0.379 0.389 -0.9	0.382 0.389 -0.7	0.332 0.342 -1.0					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.9

Figure T1 10.4.8-14: Plant T1 BOC 11 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.235 0.237 -0.2	0.306 0.305 0.1	0.302 0.301 0.1	0.302 0.302 0.0	0.234 0.236 -0.1					
B				0.564 0.569 -0.5	0.651 0.657 -0.6	1.009 1.019 -1.0	1.057 1.054 0.3	0.853 0.849 0.4	1.054 1.055 -0.1	1.007 1.014 -0.7	0.654 0.658 -0.3	0.562 0.566 -0.4			
C			0.408 0.410 -0.2	1.148 1.157 -0.9	1.159 1.171 -1.3	1.145 1.172 -2.6	1.105 1.105 0.0	1.149 1.142 0.7	1.104 1.105 -0.1	1.144 1.161 -1.6	1.158 1.164 -0.5	1.146 1.155 -1.0	0.407 0.426 -1.8		
D		0.562 0.562 0.0	1.146 1.150 -0.4	1.254 1.263 -0.8	1.226 1.230 -0.4	1.104 1.104 0.0	1.156 1.141 1.6	1.143 1.118 2.5	1.152 1.131 2.1	1.106 1.087 1.9	1.227 1.216 1.1	1.253 1.256 -0.3	1.147 1.165 -1.9	0.563 0.578 -1.5	
E		0.655 0.651 0.4	1.159 1.162 -0.2	1.228 1.245 -1.7	1.219 1.217 0.2	1.246 1.230 1.6	1.286 1.245 4.1	1.294 1.236 5.7	1.260 1.216 4.4	1.242 1.208 3.4	1.217 1.185 3.2	1.225 1.218 0.7	1.157 1.177 -2.0	0.654 0.670 -1.6	
F	0.235 0.231 0.4	1.007 0.991 1.6	1.145 1.136 0.9	1.107 1.105 0.2	1.243 1.232 1.1	1.242 1.219 2.3	1.307 1.261 4.6	1.282 1.171 11.0	1.301 1.233 6.8	1.243 1.203 3.9	1.243 1.219 2.4	1.104 1.084 2.0	1.144 1.189 -4.5	1.007 1.038 -3.1	0.235 0.242 -0.7
G	0.302 0.297 0.5	1.054 1.021 3.2	1.104 1.091 1.3	1.152 1.142 1.0	1.269 1.253 1.6	1.301 1.283 1.8	1.265 1.223 4.2	1.279 1.212 6.7	1.261 1.188 7.2	1.303 1.272 3.1	1.278 1.274 0.3	1.154 1.158 -0.4	1.101 1.119 -1.8	1.054 1.082 -2.8	0.305 0.313 -0.9
H	0.302 0.310 -0.9	0.853 0.856 -0.3	1.149 1.149 0.0	1.143 1.133 1.0	1.294 1.271 2.3	1.283 1.252 3.1	1.281 1.244 3.7	0.997 0.969 2.8	1.265 1.276 -1.1	1.276 1.267 0.9	1.290 1.289 0.1	1.140 1.160 -2.0	1.147 1.195 -4.9	0.850 0.879 -2.9	0.301 0.311 -1.0
K	0.305 0.317 -1.2	1.056 1.092 -3.5	1.105 1.123 -1.8	1.156 1.149 0.7	1.280 1.233 4.8	1.306 1.261 4.5	1.248 1.209 4.0	1.266 1.235 3.1	1.252 1.237 1.5	1.296 1.283 1.3	1.268 1.258 1.0	1.149 1.181 -3.2	1.101 1.140 -3.9	1.051 1.088 -3.7	0.301 0.312 -1.0
L	0.235 0.251 -1.6	1.009 1.087 -7.8	1.145 1.193 -4.8	1.106 1.114 -0.9	1.246 1.221 2.5	1.241 1.183 5.8	1.297 1.249 4.7	1.276 1.240 3.6	1.301 1.275 2.7	1.238 1.219 1.9	1.239 1.260 -2.1	1.104 1.132 -2.8	1.143 1.185 -4.3	1.005 1.042 -3.6	0.234 0.242 -0.8
M		0.655 0.688 -3.3	1.159 1.197 -3.9	1.226 1.248 -2.1	1.217 1.213 0.4	1.243 1.214 2.9	1.269 1.217 5.3	1.290 1.252 3.8	1.277 1.242 3.5	1.242 1.187 5.4	1.215 1.216 -0.1	1.225 1.251 -2.5	1.157 1.192 -3.5	0.652 0.676 -2.4	
N		0.564 0.586 -2.2	1.148 1.185 -3.7	1.254 1.292 -3.7	1.228 1.247 -1.9	1.107 1.106 0.1	1.151 1.135 1.7	1.141 1.118 2.3	1.154 1.149 0.5	1.103 1.097 0.6	1.224 1.238 -1.4	1.252 1.284 -3.2	1.144 1.178 -3.3	0.561 0.579 -1.8	
O			0.408 0.421 -1.3	1.147 1.182 -3.6	1.159 1.197 -3.7	1.146 1.169 -2.3	1.089 1.096 -0.7	1.148 1.149 -0.1	1.103 1.109 -0.6	1.143 1.159 -1.6	1.157 1.182 -2.6	1.146 1.195 -4.9	0.407 0.421 -1.4		
P				0.562 0.581 -1.9	0.655 0.680 -2.5	1.008 1.056 -4.8	1.054 1.080 -2.6	0.851 0.862 -1.1	1.055 1.067 -1.3	1.007 1.025 -1.8	0.654 0.669 -1.5	0.563 0.583 -2.0			
R						0.235 0.246 -1.1	0.302 0.316 -1.4	0.301 0.307 -0.6	0.305 0.311 -0.6	0.235 0.248 -1.3					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.7

Figure T1 10.4.8-15: Plant T1 MOC 11 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.274 0.272 0.1	0.364 0.356 0.8	0.366 0.361 0.5	0.361 0.360 0.1	0.273 0.273 0.0					
B				0.599 0.604 -0.5	0.659 0.663 -0.4	1.012 1.014 -0.2	1.140 1.107 3.2	0.913 0.901 1.2	1.138 1.137 0.1	1.012 1.014 -0.3	0.665 0.665 0.0	0.598 0.598 0.0			
C			0.397 0.400 -0.3	1.022 1.031 -0.9	1.091 1.102 -1.1	1.234 1.270 -3.6	1.128 1.127 0.2	1.262 1.258 0.5	1.128 1.135 -0.6	1.235 1.244 -1.0	1.092 1.091 0.0	1.021 1.021 0.0	0.397 0.403 -0.6		
D		0.598 0.600 -0.3	1.021 1.029 -0.8	1.111 1.120 -1.0	1.236 1.231 0.5	1.102 1.108 -0.6	1.255 1.251 0.4	1.127 1.116 1.1	1.252 1.243 0.9	1.106 1.097 0.9	1.238 1.229 0.9	1.111 1.106 0.5	1.022 1.020 0.3	0.599 0.584 1.5	
E		0.665 0.664 0.1	1.092 1.101 -1.0	1.238 1.263 -2.5	1.155 1.162 -0.7	1.276 1.277 -0.1	1.198 1.189 0.9	1.181 1.150 3.1	1.174 1.152 2.2	1.274 1.254 2.0	1.155 1.135 2.0	1.237 1.224 1.2	1.091 1.096 -0.5	0.665 0.666 -0.1	
F	0.273 0.267 0.6	1.012 0.996 1.6	1.235 1.242 -0.7	1.106 1.118 -1.1	1.274 1.286 -1.2	1.146 1.145 0.2	1.291 1.266 2.5	1.164 1.085 7.9	1.288 1.242 4.6	1.149 1.126 2.3	1.275 1.258 1.7	1.105 1.080 2.5	1.234 1.270 -3.6	1.012 1.026 -1.4	0.274 0.277 -0.3
G	0.361 0.350 1.1	1.138 1.086 5.2	1.128 1.119 0.9	1.253 1.262 -0.9	1.187 1.212 -2.6	1.287 1.294 -0.7	1.166 1.151 1.4	1.290 1.253 3.7	1.166 1.121 4.5	1.291 1.273 1.8	1.191 1.197 -0.5	1.255 1.250 0.5	1.126 1.124 0.1	1.140 1.145 -0.5	0.364 0.366 -0.1
H	0.366 0.372 -0.5	0.913 0.907 0.6	1.263 1.263 -0.1	1.127 1.130 -0.2	1.181 1.181 0.0	1.164 1.159 0.5	1.291 1.285 0.6	0.985 0.994 -1.0	1.282 1.301 -1.9	1.162 1.160 0.2	1.181 1.180 0.2	1.128 1.129 -0.1	1.262 1.253 0.9	0.912 0.912 0.0	0.366 0.367 -0.1
K	0.365 0.372 -0.7	1.140 1.161 -2.1	1.128 1.141 -1.3	1.255 1.255 0.0	1.191 1.166 2.5	1.290 1.271 1.9	1.147 1.134 1.3	1.281 1.276 0.6	1.160 1.159 0.2	1.287 1.279 0.7	1.190 1.181 0.9	1.253 1.270 -1.7	1.128 1.137 -0.8	1.138 1.145 -0.7	0.361 0.363 -0.2
L	0.274 0.285 -1.1	1.012 1.060 -4.8	1.234 1.271 -3.7	1.105 1.111 -0.7	1.276 1.262 1.3	1.145 1.118 2.8	1.284 1.258 2.6	1.161 1.146 1.5	1.290 1.279 1.1	1.146 1.131 1.5	1.274 1.291 -1.7	1.107 1.120 -1.3	1.235 1.257 -2.2	1.012 1.022 -1.0	0.273 0.275 -0.2
M		0.665 0.684 -1.9	1.091 1.108 -1.7	1.236 1.247 -1.1	1.152 1.148 0.4	1.274 1.253 2.1	1.189 1.147 4.2	1.180 1.161 1.9	1.191 1.181 1.0	1.275 1.211 6.4	1.154 1.146 0.9	1.238 1.246 -0.8	1.092 1.102 -1.0	0.664 0.665 -0.1	
N		0.599 0.612 -1.3	1.022 1.039 -1.7	1.111 1.128 -1.7	1.238 1.245 -0.8	1.106 1.103 0.3	1.252 1.239 1.2	1.126 1.119 0.8	1.255 1.280 -2.6	1.105 1.103 0.2	1.237 1.242 -0.5	1.111 1.122 -1.1	1.021 1.031 -1.0	0.598 0.602 -0.4	
O			0.397 0.403 -0.6	1.021 1.036 -1.5	1.091 1.105 -1.4	1.234 1.250 -1.7	1.104 1.111 -0.6	1.261 1.271 -0.9	1.128 1.147 -1.9	1.234 1.262 -2.8	1.091 1.107 -1.6	1.023 1.041 -1.8	0.397 0.402 -0.5		
P				0.598 0.607 -1.0	0.664 0.676 -1.2	1.010 1.035 -2.4	1.136 1.154 -1.8	0.910 0.922 -1.2	1.139 1.160 -2.1	1.012 1.034 -2.2	0.665 0.677 -1.2	0.599 0.610 -1.0			
R						0.273 0.279 -0.7	0.361 0.370 -0.9	0.366 0.372 -0.6	0.364 0.372 -0.8	0.274 0.285 -1.1					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.7

Figure T1 10.4.8-16: Plant T1 EOC 11 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.327 0.320 0.7	0.422 0.404 1.8	0.428 0.412 1.5	0.418 0.404 1.4	0.326 0.314 1.3					
B				0.680 0.680 0.0	0.713 0.710 0.3	1.022 1.010 1.2	1.117 1.062 5.5	0.917 0.886 3.1	1.116 1.081 3.5	1.021 0.982 4.0	0.721 0.691 3.0	0.678 0.650 2.9			
C			0.453 0.455 -0.2	1.029 1.032 -0.3	1.094 1.095 -0.1	1.267 1.293 -2.5	1.096 1.077 1.9	1.230 1.199 3.1	1.096 1.070 2.5	1.268 1.214 5.4	1.094 1.047 4.8	1.028 0.984 4.4	0.453 0.436 1.7		
D		0.678 0.682 -0.3	1.028 1.036 -0.8	1.088 1.094 -0.6	1.268 1.251 1.7	1.094 1.089 0.4	1.258 1.238 2.0	1.071 1.040 3.1	1.257 1.211 4.6	1.099 1.051 4.8	1.269 1.213 5.6	1.089 1.042 4.7	1.029 0.982 4.7	0.680 0.625 5.5	
E		0.721 0.722 -0.1	1.094 1.107 -1.3	1.269 1.295 -2.6	1.139 1.144 -0.5	1.286 1.281 0.5	1.139 1.122 1.6	1.107 1.058 4.9	1.117 1.059 5.8	1.286 1.228 5.8	1.139 1.085 5.4	1.268 1.212 5.6	1.094 1.061 3.3	0.721 0.695 2.6	
F	0.326 0.320 0.6	1.021 1.009 1.2	1.268 1.288 -2.0	1.099 1.117 -1.8	1.286 1.306 -2.0	1.097 1.093 0.4	1.259 1.222 3.7	1.085 0.995 9.0	1.258 1.191 6.7	1.100 1.057 4.3	1.286 1.239 4.7	1.097 1.035 6.2	1.268 1.271 -0.3	1.022 1.010 1.2	0.327 0.323 0.4
G	0.418 0.405 1.3	1.116 1.061 5.5	1.096 1.093 0.2	1.257 1.279 -2.2	1.131 1.179 -4.8	1.257 1.265 -0.8	1.079 1.068 1.1	1.196 1.165 3.1	1.082 1.038 4.4	1.260 1.235 2.5	1.132 1.126 0.6	1.258 1.234 2.5	1.093 1.079 1.3	1.117 1.105 1.3	0.422 0.417 0.5
H	0.428 0.431 -0.3	0.917 0.910 0.6	1.230 1.236 -0.6	1.072 1.083 -1.2	1.107 1.116 -0.9	1.085 1.092 -0.7	1.196 1.208 -1.2	0.922 0.960 -3.8	1.193 1.224 -3.2	1.085 1.090 -0.4	1.108 1.109 -0.2	1.072 1.067 0.5	1.230 1.197 3.3	0.916 0.905 1.1	0.428 0.424 0.4
K	0.422 0.430 -0.8	1.117 1.138 -2.1	1.096 1.112 -1.6	1.258 1.269 -1.1	1.132 1.125 0.6	1.259 1.263 -0.3	1.061 1.070 -0.8	1.193 1.215 -2.2	1.078 1.097 -1.8	1.259 1.271 -1.2	1.135 1.149 -1.4	1.257 1.286 -2.9	1.096 1.106 -1.0	1.116 1.123 -0.7	0.418 0.419 -0.1
L	0.327 0.339 -1.2	1.022 1.068 -4.6	1.268 1.305 -3.7	1.097 1.113 -1.6	1.286 1.293 -0.7	1.097 1.097 -0.1	1.257 1.260 -0.3	1.085 1.098 -1.3	1.260 1.280 -2.0	1.098 1.101 -0.4	1.286 1.334 -4.7	1.099 1.130 -3.1	1.269 1.316 -4.7	1.022 1.040 -1.8	0.326 0.330 -0.4
M		0.721 0.741 -2.0	1.094 1.111 -1.6	1.268 1.290 -2.2	1.136 1.148 -1.2	1.286 1.291 -0.5	1.134 1.120 1.4	1.108 1.123 -1.5	1.132 1.164 -3.2	1.287 1.229 5.8	1.139 1.147 -0.8	1.270 1.296 -2.6	1.095 1.118 -2.4	0.719 0.723 -0.4	
N		0.680 0.696 -1.7	1.029 1.052 -2.3	1.089 1.118 -2.9	1.269 1.293 -2.4	1.099 1.114 -1.5	1.257 1.275 -1.8	1.072 1.103 -3.1	1.258 1.322 -6.3	1.098 1.116 -1.8	1.269 1.294 -2.5	1.089 1.113 -2.5	1.028 1.049 -2.1	0.679 0.689 -1.0	
O			0.453 0.463 -1.0	1.028 1.052 -2.4	1.094 1.117 -2.3	1.268 1.300 -3.1	1.069 1.096 -2.7	1.230 1.271 -4.1	1.096 1.142 -4.6	1.268 1.329 -6.0	1.094 1.128 -3.3	1.029 1.054 -2.5	0.453 0.463 -1.0		
P				0.679 0.695 -1.7	0.721 0.739 -1.8	1.021 1.052 -3.1	1.116 1.154 -3.8	0.915 0.948 -3.3	1.117 1.163 -4.6	1.022 1.065 -4.3	0.721 0.745 -2.4	0.680 0.699 -1.9			
R						0.326 0.338 -1.2	0.418 0.441 -2.3	0.428 0.445 -1.8	0.422 0.439 -1.7	0.327 0.342 -1.5					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.9

Figure T1 10.4.8-17: Plant T1 BOC 12 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.299 0.295 0.4	0.355 0.351 0.4	0.311 0.312 0.0	0.354 0.355 -0.1	0.297 0.298 -0.1					
B				0.431 0.419 1.2	0.696 0.681 1.5	1.131 1.112 1.8	1.152 1.137 1.5	0.783 0.788 -0.4	1.149 1.152 -0.3	1.119 1.124 -0.5	0.691 0.694 -0.3	0.429 0.432 -0.3			
C			0.524 0.505 1.8	1.167 1.132 3.6	1.255 1.224 3.1	1.219 1.201 1.8	1.091 1.077 1.4	1.156 1.150 0.5	1.085 1.083 0.2	1.199 1.208 -0.9	1.248 1.253 -0.5	1.164 1.174 -0.9	0.524 0.540 -1.7		
D		0.429 0.412 1.8	1.165 1.119 4.5	1.141 1.101 4.0	1.287 1.248 3.9	1.097 1.073 2.3	1.213 1.193 2.0	1.022 1.014 0.8	1.206 1.202 0.4	1.087 1.096 -0.8	1.282 1.279 0.3	1.142 1.144 -0.2	1.168 1.178 -1.0	0.431 0.444 -1.2	
E		0.692 0.662 3.0	1.248 1.195 5.3	1.282 1.233 5.0	1.170 1.132 3.7	1.275 1.243 3.2	1.167 1.137 3.0	1.069 1.063 0.6	1.162 1.147 1.6	1.270 1.257 1.2	1.170 1.143 2.7	1.288 1.283 0.6	1.257 1.254 0.3	0.698 0.697 0.1	
F	0.298 0.285 1.2	1.121 1.070 5.1	1.202 1.142 6.0	1.088 1.049 3.9	1.271 1.233 3.8	1.182 1.152 2.9	1.265 1.240 2.6	1.109 1.140 -3.1	1.262 1.254 0.8	1.181 1.168 1.3	1.276 1.264 1.2	1.099 1.104 -0.5	1.223 1.209 1.4	1.133 1.122 1.1	0.300 0.297 0.3
G	0.354 0.343 1.1	1.153 1.106 4.7	1.070 1.033 3.8	1.209 1.174 3.5	1.164 1.131 3.3	1.265 1.239 2.6	1.157 1.135 2.2	1.238 1.222 1.6	1.152 1.119 3.3	1.265 1.245 1.9	1.168 1.156 1.2	1.217 1.207 1.0	1.082 1.059 2.2	1.156 1.141 1.5	0.356 0.352 0.4
H	0.312 0.318 -0.6	0.785 0.770 1.5	1.159 1.136 2.3	1.024 1.005 1.9	1.072 1.056 1.6	1.114 1.096 1.7	1.250 1.226 2.5	0.966 0.929 3.6	1.239 1.209 3.0	1.110 1.094 1.7	1.071 1.059 1.2	1.027 1.017 1.0	1.160 1.139 2.0	0.786 0.781 0.5	0.313 0.311 0.1
K	0.356 0.355 0.1	1.154 1.145 0.8	1.091 1.083 0.8	1.215 1.204 1.1	1.169 1.151 1.8	1.269 1.261 0.8	1.163 1.150 1.3	1.250 1.231 1.9	1.158 1.143 1.5	1.265 1.257 0.8	1.165 1.153 1.2	1.209 1.209 0.0	1.088 1.094 -0.7	1.152 1.163 -1.2	0.355 0.358 -0.3
L	0.300 0.300 0.0	1.132 1.132 0.0	1.221 1.228 -0.8	1.098 1.102 -0.4	1.277 1.281 -0.4	1.183 1.202 -1.8	1.267 1.267 0.1	1.114 1.108 0.6	1.268 1.264 0.4	1.182 1.194 -1.1	1.271 1.310 -3.9	1.089 1.116 -2.7	1.201 1.240 -3.9	1.120 1.150 -3.0	0.298 0.304 -0.7
M		0.697 0.703 -0.6	1.256 1.276 -2.0	1.288 1.302 -1.4	1.170 1.180 -1.1	1.271 1.283 -1.2	1.165 1.162 0.3	1.072 1.070 0.2	1.169 1.163 0.6	1.277 1.302 -2.6	1.170 1.206 -3.5	1.283 1.328 -4.5	1.249 1.297 -4.8	0.692 0.724 -3.2	
N		0.431 0.436 -0.5	1.168 1.184 -1.7	1.141 1.157 -1.6	1.282 1.300 -1.8	1.088 1.104 -1.6	1.208 1.223 -1.5	1.026 1.037 -1.1	1.215 1.223 -0.8	1.097 1.125 -2.7	1.288 1.336 -4.8	1.142 1.193 -5.1	1.165 1.216 -5.1	0.429 0.448 -1.9	
O			0.524 0.531 -0.8	1.164 1.182 -1.8	1.247 1.269 -2.2	1.200 1.225 -2.5	1.086 1.115 -2.9	1.157 1.187 -3.0	1.093 1.122 -2.9	1.220 1.261 -4.1	1.256 1.313 -5.7	1.168 1.245 -7.7	0.524 0.552 -2.9		
P				0.429 0.437 -0.8	0.691 0.707 -1.6	1.119 1.155 -3.6	1.150 1.207 -5.7	0.783 0.817 -3.4	1.151 1.198 -4.7	1.130 1.184 -5.3	0.697 0.730 -3.3	0.431 0.456 -2.5			
R						0.297 0.319 -2.2	0.354 0.423 -6.9	0.312 0.338 -2.6	0.349 0.371 -2.2	0.299 0.337 -3.8					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.5

Figure T1 10.4.8-18: Plant T1 MOC 12 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.322 0.323 0.0	0.390 0.390 0.0	0.353 0.357 -0.4	0.391 0.397 -0.6	0.322 0.327 -0.5					
B				0.433 0.433 0.0	0.676 0.678 -0.2	1.083 1.087 -0.4	1.172 1.169 0.4	0.816 0.830 -1.5	1.173 1.194 -2.0	1.079 1.098 -1.9	0.675 0.683 -0.8	0.432 0.436 -0.3			
C			0.517 0.514 0.2	1.109 1.109 0.0	1.157 1.162 -0.5	1.300 1.313 -1.3	1.083 1.088 -0.5	1.239 1.254 -1.5	1.083 1.100 -1.7	1.288 1.314 -2.6	1.155 1.166 -1.2	1.108 1.115 -0.7	0.517 0.519 -0.3		
D		0.432 0.427 0.5	1.108 1.099 0.9	1.045 1.043 0.2	1.315 1.320 -0.5	1.092 1.096 -0.3	1.282 1.286 -0.4	1.006 1.016 -1.0	1.278 1.290 -1.3	1.088 1.108 -2.0	1.313 1.317 -0.4	1.045 1.048 -0.2	1.109 1.108 0.0	0.432 0.428 0.4	
E		0.674 0.664 0.9	1.154 1.138 1.6	1.312 1.298 1.3	1.138 1.133 0.5	1.339 1.337 0.2	1.124 1.116 0.7	1.016 1.027 -1.0	1.122 1.115 0.7	1.336 1.331 0.4	1.139 1.116 2.3	1.315 1.310 0.4	1.156 1.154 0.3	0.675 0.672 0.3	
F	0.321 0.318 0.4	1.077 1.062 1.4	1.286 1.259 2.7	1.086 1.072 1.3	1.335 1.326 0.9	1.151 1.151 0.0	1.306 1.319 -1.3	1.059 1.109 -5.0	1.304 1.309 -0.5	1.150 1.143 0.7	1.339 1.328 1.1	1.092 1.099 -0.7	1.299 1.297 0.2	1.081 1.076 0.6	0.322 0.319 0.3
G	0.388 0.388 0.0	1.171 1.164 0.7	1.053 1.042 1.1	1.276 1.264 1.2	1.121 1.107 1.5	1.305 1.308 -0.3	1.108 1.109 -0.1	1.253 1.256 -0.3	1.105 1.082 2.3	1.306 1.286 1.9	1.124 1.107 1.6	1.281 1.271 1.1	1.062 1.047 1.5	1.171 1.159 1.2	0.390 0.386 0.4
H	0.352 0.366 -1.4	0.814 0.816 -0.2	1.237 1.236 0.1	1.004 1.000 0.4	1.016 1.009 0.7	1.061 1.055 0.6	1.261 1.250 1.0	0.942 0.920 2.2	1.253 1.221 3.2	1.059 1.038 2.1	1.017 0.996 2.1	1.007 0.995 1.2	1.239 1.220 1.8	0.815 0.805 1.0	0.353 0.349 0.4
K	0.390 0.395 -0.5	1.171 1.180 -0.9	1.079 1.085 -0.6	1.281 1.279 0.2	1.124 1.106 1.8	1.308 1.300 0.7	1.111 1.100 1.1	1.261 1.242 1.9	1.108 1.088 2.0	1.305 1.283 2.3	1.122 1.086 3.6	1.278 1.266 1.2	1.083 1.073 0.9	1.173 1.163 1.0	0.390 0.387 0.4
L	0.322 0.325 -0.3	1.082 1.093 -1.1	1.299 1.326 -2.6	1.092 1.099 -0.7	1.339 1.339 0.0	1.151 1.157 -0.6	1.307 1.297 0.9	1.061 1.049 1.3	1.308 1.292 1.5	1.151 1.150 0.1	1.336 1.360 -2.4	1.088 1.091 -0.3	1.288 1.288 -0.1	1.079 1.073 0.6	0.322 0.319 0.3
M		0.676 0.684 -0.8	1.157 1.174 -1.7	1.315 1.327 -1.3	1.139 1.142 -0.3	1.336 1.335 0.1	1.123 1.106 1.7	1.017 1.006 1.1	1.125 1.104 2.1	1.339 1.351 -1.1	1.139 1.150 -1.1	1.313 1.319 -0.6	1.155 1.155 0.0	0.675 0.667 0.8	
N		0.433 0.438 -0.5	1.109 1.123 -1.4	1.045 1.058 -1.3	1.313 1.319 -0.6	1.088 1.090 -0.3	1.278 1.278 0.0	1.008 1.014 -0.7	1.282 1.284 -0.2	1.093 1.100 -0.7	1.315 1.326 -1.1	1.045 1.052 -0.6	1.108 1.111 -0.2	0.432 0.431 0.2	
O			0.517 0.522 -0.5	1.108 1.116 -0.8	1.155 1.156 -0.1	1.288 1.297 -0.9	1.083 1.089 -0.6	1.239 1.249 -0.9	1.086 1.094 -0.8	1.300 1.314 -1.4	1.157 1.167 -1.0	1.109 1.115 -0.6	0.517 0.519 -0.2		
P				0.432 0.435 -0.3	0.675 0.680 -0.5	1.079 1.097 -1.8	1.173 1.186 -1.3	0.815 0.823 -0.8	1.172 1.186 -1.5	1.083 1.100 -1.7	0.676 0.683 -0.7	0.433 0.436 -0.3			
R						0.322 0.326 -0.4	0.391 0.394 -0.3	0.353 0.357 -0.4	0.383 0.390 -0.8	0.322 0.342 -2.0					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.2

Figure T1 10.4.8-19: Plant T1 EOC 12 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.363 0.364 -0.1	0.434 0.435 0.0	0.406 0.411 -0.5	0.435 0.440 -0.5	0.364 0.366 -0.3					
B				0.472 0.472 0.0	0.697 0.699 -0.2	1.039 1.043 -0.3	1.122 1.118 0.4	0.831 0.849 -1.8	1.124 1.139 -1.5	1.040 1.046 -0.7	0.698 0.697 0.0	0.473 0.470 0.3			
C			0.545 0.543 0.2	1.058 1.059 -0.1	1.105 1.111 -0.6	1.299 1.311 -1.2	1.059 1.065 -0.5	1.266 1.281 -1.5	1.063 1.076 -1.3	1.296 1.301 -0.5	1.106 1.101 0.5	1.059 1.050 0.9	0.545 0.538 0.7		
D		0.473 0.468 0.5	1.059 1.050 0.8	1.005 1.003 0.2	1.316 1.324 -0.8	1.142 1.148 -0.6	1.311 1.317 -0.6	1.009 1.017 -0.7	1.311 1.312 -0.1	1.142 1.136 0.6	1.316 1.301 1.5	1.005 0.994 1.2	1.058 1.044 1.4	0.472 0.462 1.0	
E		0.697 0.688 0.9	1.106 1.091 1.5	1.316 1.302 1.4	1.113 1.110 0.2	1.347 1.349 -0.2	1.095 1.094 0.1	0.998 1.010 -1.2	1.095 1.084 1.1	1.347 1.331 1.6	1.113 1.084 2.9	1.316 1.296 1.9	1.105 1.091 1.4	0.696 0.687 1.0	
F	0.363 0.360 0.3	1.039 1.025 1.4	1.296 1.268 2.8	1.140 1.128 1.2	1.346 1.342 0.5	1.113 1.115 -0.2	1.307 1.318 -1.1	1.036 1.093 -5.7	1.307 1.318 -1.1	1.113 1.106 0.7	1.347 1.330 1.7	1.141 1.132 1.0	1.299 1.287 1.2	1.038 1.027 1.2	0.363 0.358 0.4
G	0.433 0.434 -0.1	1.124 1.119 0.5	1.028 1.020 0.9	1.310 1.303 0.8	1.095 1.090 0.5	1.306 1.311 -0.5	1.086 1.095 -0.9	1.284 1.306 -2.2	1.085 1.081 0.4	1.307 1.297 1.0	1.095 1.082 1.3	1.311 1.295 1.5	1.035 1.023 1.2	1.121 1.107 1.4	0.434 0.428 0.6
H	0.405 0.421 -1.5	0.831 0.834 -0.4	1.266 1.266 -0.1	1.008 1.007 0.1	0.997 0.998 -0.1	1.036 1.039 -0.3	1.287 1.295 -0.8	0.973 0.980 -0.8	1.284 1.268 1.6	1.036 1.024 1.2	0.997 0.982 1.6	1.010 0.994 1.6	1.266 1.242 2.4	0.831 0.818 1.3	0.406 0.400 0.6
K	0.434 0.440 -0.6	1.122 1.130 -0.8	1.056 1.062 -0.6	1.310 1.311 -0.1	1.095 1.080 1.4	1.307 1.310 -0.4	1.086 1.089 -0.3	1.287 1.289 -0.2	1.085 1.079 0.7	1.306 1.293 1.3	1.095 1.069 2.6	1.310 1.288 2.3	1.063 1.047 1.6	1.124 1.109 1.5	0.435 0.429 0.6
L	0.363 0.366 -0.3	1.039 1.048 -0.8	1.299 1.321 -2.2	1.142 1.152 -1.0	1.347 1.354 -0.8	1.112 1.130 -1.8	1.306 1.311 -0.4	1.036 1.036 0.0	1.307 1.304 0.3	1.113 1.113 0.0	1.346 1.361 -1.5	1.141 1.137 0.5	1.295 1.285 1.0	1.039 1.027 1.2	0.364 0.359 0.5
M		0.697 0.705 -0.9	1.105 1.123 -1.8	1.316 1.334 -1.9	1.112 1.122 -1.0	1.346 1.354 -0.8	1.095 1.086 0.9	0.997 0.997 0.0	1.095 1.089 0.5	1.347 1.350 -0.3	1.112 1.116 -0.4	1.316 1.313 0.3	1.106 1.099 0.7	0.698 0.687 1.0	
N		0.472 0.479 -0.7	1.058 1.077 -2.0	1.005 1.029 -2.4	1.316 1.330 -1.4	1.141 1.147 -0.6	1.310 1.316 -0.6	1.010 1.024 -1.4	1.310 1.307 0.4	1.142 1.143 -0.2	1.315 1.318 -0.2	1.005 1.004 0.1	1.058 1.054 0.4	0.472 0.468 0.4	
O			0.545 0.554 -0.9	1.058 1.074 -1.5	1.106 1.112 -0.6	1.295 1.299 -0.3	1.063 1.069 -0.6	1.266 1.276 -1.0	1.062 1.067 -0.5	1.299 1.305 -0.7	1.105 1.108 -0.3	1.058 1.057 0.0	0.545 0.544 0.1		
P				0.473 0.479 -0.6	0.698 0.706 -0.8	1.040 1.058 -1.9	1.124 1.135 -1.1	0.831 0.838 -0.7	1.121 1.131 -1.0	1.039 1.050 -1.1	0.697 0.700 -0.4	0.472 0.473 -0.1			
R						0.364 0.368 -0.4	0.435 0.436 0.0	0.406 0.409 -0.3	0.425 0.432 -0.7	0.363 0.380 -1.7					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.1

Figure T1 10.4.8-20: Plant T1 BOC 13 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.298 0.288 1.0	0.313 0.301 1.2	0.300 0.286 1.4	0.316 0.308 0.9	0.303 0.300 0.3					
B				0.320 0.311 0.9	0.622 0.604 1.8	1.092 1.056 3.6	1.190 1.146 4.5	0.972 0.920 5.2	1.196 1.162 3.3	1.100 1.094 0.7	0.627 0.631 -0.4	0.322 0.328 -0.6			
C			0.512 0.496 1.6	1.025 0.996 2.9	1.047 1.021 2.7	1.218 1.184 3.4	1.237 1.199 3.8	1.295 1.254 4.1	1.241 1.209 3.2	1.225 1.238 -1.4	1.054 1.069 -1.5	1.027 1.052 -2.5	0.512 0.540 -2.9		
D		0.322 0.312 1.0	1.027 0.994 3.3	1.159 1.126 3.3	1.247 1.225 2.2	1.184 1.159 2.5	1.234 1.204 3.0	1.157 1.133 2.5	1.237 1.224 1.3	1.181 1.193 -1.2	1.248 1.264 -1.6	1.159 1.186 -2.7	1.025 1.060 -3.6	0.320 0.340 -2.0	
E		0.627 0.608 1.9	1.055 1.018 3.7	1.248 1.201 4.7	1.282 1.251 3.1	1.265 1.239 2.6	1.178 1.149 2.9	1.171 1.150 2.1	1.173 1.168 0.5	1.251 1.255 -0.5	1.282 1.289 -0.6	1.246 1.273 -2.7	1.047 1.079 -3.2	0.621 0.642 -2.0	
F	0.303 0.297 0.6	1.100 1.072 2.8	1.224 1.178 4.6	1.181 1.149 3.2	1.250 1.224 2.5	1.255 1.240 1.5	1.233 1.228 0.5	1.183 1.160 2.3	1.221 1.213 0.8	1.257 1.261 -0.4	1.265 1.281 -1.6	1.183 1.217 -3.5	1.216 1.259 -4.2	1.090 1.119 -2.9	0.298 0.305 -0.8
G	0.316 0.317 -0.1	1.194 1.181 1.3	1.240 1.215 2.5	1.236 1.211 2.5	1.171 1.151 2.0	1.219 1.215 0.4	1.140 1.128 1.2	1.214 1.192 2.1	1.144 1.137 0.7	1.234 1.239 -0.4	1.177 1.193 -1.6	1.232 1.251 -1.9	1.235 1.245 -1.0	1.187 1.207 -2.0	0.309 0.315 -0.6
H	0.299 0.321 -2.2	0.969 0.965 0.4	1.293 1.277 1.6	1.156 1.139 1.8	1.170 1.150 1.9	1.182 1.166 1.6	1.204 1.182 2.1	0.940 0.905 3.5	1.214 1.208 0.6	1.183 1.186 -0.3	1.169 1.178 -0.8	1.156 1.168 -1.3	1.291 1.307 -1.6	0.968 0.984 -1.6	0.298 0.304 -0.5
K	0.301 0.303 -0.2	1.187 1.178 0.9	1.235 1.225 0.9	1.232 1.218 1.5	1.177 1.155 2.2	1.231 1.212 1.9	1.135 1.120 1.5	1.204 1.188 1.6	1.139 1.137 0.2	1.219 1.224 -0.6	1.171 1.172 -0.2	1.234 1.245 -1.1	1.237 1.257 -2.0	1.190 1.213 -2.3	0.302 0.308 -0.6
L	0.297 0.295 0.2	1.089 1.075 1.3	1.216 1.217 -0.1	1.182 1.176 0.7	1.264 1.249 1.5	1.253 1.234 2.0	1.217 1.206 1.1	1.182 1.176 0.5	1.232 1.238 -0.6	1.255 1.274 -1.9	1.248 1.289 -4.0	1.179 1.208 -2.9	1.221 1.251 -2.9	1.096 1.126 -3.0	0.302 0.310 -0.8
M		0.621 0.615 0.6	1.046 1.040 0.7	1.246 1.239 0.7	1.282 1.272 1.0	1.249 1.241 0.8	1.170 1.170 0.1	1.169 1.168 0.1	1.177 1.188 -1.1	1.264 1.288 -2.4	1.281 1.317 -3.6	1.246 1.284 -3.8	1.053 1.088 -3.5	0.625 0.657 -3.1	
N		0.320 0.318 0.2	1.024 1.019 0.6	1.159 1.157 0.1	1.247 1.238 0.9	1.180 1.180 0.0	1.235 1.235 0.0	1.156 1.147 1.0	1.233 1.247 -1.5	1.182 1.211 -2.9	1.246 1.285 -3.9	1.158 1.201 -4.3	1.026 1.064 -3.8	0.322 0.335 -1.4	
O			0.511 0.508 0.4	1.027 1.016 1.1	1.054 1.034 2.0	1.224 1.233 -0.9	1.240 1.250 -1.0	1.293 1.304 -1.1	1.236 1.259 -2.4	1.217 1.254 -3.8	1.046 1.085 -3.9	1.024 1.077 -5.3	0.511 0.534 -2.3		
P				0.322 0.320 0.2	0.627 0.625 0.2	1.100 1.116 -1.6	1.195 1.213 -1.8	0.971 0.987 -1.7	1.189 1.219 -3.0	1.090 1.130 -4.0	0.621 0.645 -2.4	0.320 0.335 -1.5			
R						0.303 0.310 -0.7	0.316 0.331 -1.5	0.300 0.308 -0.8	0.311 0.323 -1.2	0.298 0.330 -3.2					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.2

Figure T1 10.4.8-21: Plant T1 MOC 13 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.315 0.316 -0.1	0.323 0.322 0.1	0.307 0.301 0.6	0.326 0.323 0.3	0.318 0.319 -0.1					
B				0.337 0.339 -0.2	0.626 0.629 -0.4	1.078 1.085 -0.7	1.129 1.131 -0.1	0.890 0.865 2.5	1.131 1.121 1.0	1.082 1.089 -0.7	0.628 0.631 -0.3	0.338 0.339 -0.1			
C			0.518 0.519 -0.1	1.021 1.026 -0.5	1.008 1.016 -0.8	1.283 1.296 -1.4	1.137 1.137 0.0	1.268 1.257 1.1	1.139 1.128 1.1	1.286 1.312 -2.6	1.012 1.018 -0.6	1.021 1.022 -0.1	0.518 0.516 0.2		
D		0.338 0.338 0.0	1.021 1.022 -0.1	1.098 1.100 -0.3	1.328 1.340 -1.3	1.152 1.157 -0.6	1.283 1.282 0.1	1.069 1.064 0.4	1.284 1.282 0.2	1.149 1.155 -0.6	1.328 1.325 0.2	1.098 1.095 0.3	1.021 1.018 0.2	0.337 0.336 0.1	
E		0.628 0.629 -0.1	1.013 1.010 0.2	1.328 1.320 0.8	1.233 1.235 -0.2	1.352 1.356 -0.4	1.120 1.115 0.6	1.076 1.068 0.8	1.116 1.116 0.0	1.340 1.334 0.7	1.234 1.213 2.0	1.328 1.319 0.9	1.008 1.006 0.3	0.626 0.624 0.2	
F	0.318 0.322 -0.4	1.082 1.090 -0.8	1.286 1.284 0.2	1.150 1.148 0.2	1.340 1.342 -0.2	1.221 1.230 -1.0	1.330 1.353 -2.4	1.147 1.128 2.0	1.320 1.306 1.4	1.221 1.209 1.2	1.352 1.339 1.4	1.151 1.145 0.6	1.283 1.288 -0.5	1.078 1.075 0.3	0.315 0.313 0.2
G	0.326 0.335 -0.9	1.131 1.151 -2.0	1.139 1.146 -0.7	1.284 1.286 -0.1	1.116 1.111 0.5	1.319 1.335 -1.7	1.161 1.163 -0.2	1.375 1.357 1.8	1.164 1.145 1.9	1.330 1.315 1.5	1.121 1.108 1.2	1.283 1.267 1.5	1.137 1.112 2.6	1.129 1.118 1.1	0.321 0.317 0.3
H	0.307 0.333 -2.7	0.890 0.907 -1.7	1.268 1.282 -1.4	1.069 1.072 -0.3	1.076 1.068 0.8	1.148 1.144 0.3	1.367 1.357 1.1	1.025 0.999 2.5	1.375 1.366 0.9	1.148 1.134 1.3	1.076 1.059 1.6	1.069 1.058 1.1	1.268 1.266 0.2	0.889 0.884 0.5	0.306 0.304 0.2
K	0.313 0.321 -0.8	1.129 1.145 -1.6	1.137 1.153 -1.6	1.283 1.289 -0.6	1.121 1.112 0.8	1.329 1.319 1.0	1.159 1.147 1.2	1.368 1.349 1.8	1.161 1.149 1.2	1.319 1.304 1.5	1.116 1.086 3.0	1.284 1.267 1.8	1.139 1.132 0.6	1.130 1.126 0.4	0.313 0.311 0.2
L	0.314 0.317 -0.3	1.078 1.084 -0.6	1.283 1.319 -3.6	1.152 1.161 -0.9	1.352 1.349 0.3	1.220 1.207 1.3	1.318 1.305 1.3	1.148 1.134 1.3	1.330 1.318 1.2	1.221 1.221 0.0	1.340 1.364 -2.4	1.149 1.151 -0.2	1.286 1.286 0.0	1.082 1.081 0.0	0.318 0.317 0.1
M		0.626 0.628 -0.2	1.009 1.011 -0.3	1.328 1.334 -0.6	1.234 1.232 0.2	1.340 1.334 0.7	1.116 1.105 1.1	1.076 1.063 1.3	1.121 1.103 1.8	1.352 1.357 -0.4	1.234 1.244 -1.1	1.328 1.336 -0.8	1.013 1.016 -0.3	0.628 0.630 -0.2	
N		0.337 0.338 -0.1	1.021 1.025 -0.5	1.098 1.106 -0.8	1.328 1.326 0.2	1.149 1.150 -0.1	1.284 1.281 0.4	1.069 1.058 1.1	1.283 1.292 -0.9	1.151 1.162 -1.1	1.328 1.341 -1.3	1.098 1.106 -0.8	1.022 1.027 -0.5	0.338 0.339 -0.1	
O			0.518 0.518 0.0	1.021 1.018 0.3	1.013 0.996 1.7	1.286 1.304 -1.7	1.139 1.146 -0.7	1.268 1.274 -0.6	1.137 1.150 -1.3	1.283 1.309 -2.6	1.008 1.021 -1.2	1.021 1.027 -0.6	0.518 0.521 -0.3		
P				0.338 0.337 0.1	0.628 0.626 0.2	1.082 1.093 -1.1	1.131 1.143 -1.2	0.890 0.899 -0.9	1.129 1.147 -1.7	1.078 1.101 -2.3	0.626 0.635 -1.0	0.337 0.340 -0.3			
R						0.318 0.322 -0.4	0.326 0.335 -0.9	0.307 0.311 -0.5	0.322 0.329 -0.7	0.315 0.332 -1.7					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.1

Figure T1 10.4.8-22: Plant T1 EOC 13 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.369 0.371 -0.2	0.379 0.379 0.0	0.366 0.361 0.5	0.382 0.379 0.2	0.372 0.373 -0.1					
B				0.398 0.403 -0.5	0.682 0.690 -0.8	1.064 1.073 -0.9	1.101 1.104 -0.3	0.900 0.881 1.8	1.102 1.097 0.5	1.066 1.072 -0.7	0.683 0.687 -0.4	0.399 0.402 -0.3		Calculated power Measured power Difference (C-M)*100	
C			0.578 0.585 -0.8	1.027 1.042 -1.5	1.007 1.023 -1.6	1.274 1.291 -1.6	1.105 1.109 -0.4	1.251 1.246 0.5	1.105 1.100 0.5	1.276 1.297 -2.1	1.009 1.015 -0.6	1.027 1.037 -1.1	0.578 0.600 -2.2		
D		0.399 0.404 -0.5	1.027 1.040 -1.3	1.062 1.077 -1.5	1.301 1.332 -3.1	1.193 1.207 -1.5	1.306 1.315 -0.8	1.050 1.049 0.0	1.308 1.305 0.3	1.192 1.180 1.2	1.301 1.292 1.0	1.062 1.062 0.0	1.027 1.042 -1.5	0.398 0.424 -2.5	
E		0.683 0.693 -1.0	1.009 1.019 -1.0	1.301 1.309 -0.7	1.182 1.194 -1.2	1.350 1.363 -1.2	1.095 1.101 -0.6	1.047 1.044 0.2	1.094 1.097 -0.3	1.345 1.329 1.6	1.182 1.154 2.9	1.301 1.283 1.8	1.007 1.003 0.4	0.682 0.685 -0.3	
F	0.372 0.381 -0.9	1.066 1.086 -2.0	1.276 1.290 -1.4	1.192 1.199 -0.7	1.345 1.352 -0.7	1.169 1.176 -0.7	1.307 1.324 -1.8	1.091 1.075 1.5	1.302 1.286 1.6	1.169 1.149 2.0	1.350 1.322 2.8	1.192 1.161 3.1	1.275 1.262 1.3	1.064 1.054 1.0	0.369 0.365 0.4
G	0.381 0.396 -1.5	1.102 1.135 -3.3	1.106 1.121 -1.6	1.309 1.316 -0.7	1.094 1.088 0.6	1.302 1.301 0.1	1.096 1.092 0.5	1.295 1.275 2.0	1.097 1.071 2.6	1.307 1.280 2.6	1.095 1.074 2.0	1.307 1.276 3.0	1.105 1.076 2.9	1.102 1.083 1.9	0.376 0.370 0.7
H	0.366 0.398 -3.2	0.900 0.923 -2.4	1.252 1.271 -2.0	1.050 1.056 -0.6	1.048 1.035 1.2	1.092 1.083 0.9	1.293 1.279 1.4	0.979 0.956 2.3	1.295 1.263 3.2	1.091 1.064 2.7	1.047 1.018 2.8	1.050 1.024 2.5	1.252 1.231 2.1	0.900 0.884 1.6	0.366 0.359 0.7
K	0.368 0.378 -1.0	1.102 1.120 -1.8	1.105 1.123 -1.8	1.307 1.316 -0.9	1.095 1.086 0.9	1.308 1.298 1.0	1.096 1.084 1.2	1.293 1.271 2.1	1.097 1.073 2.4	1.302 1.270 3.2	1.094 1.051 4.3	1.309 1.268 4.1	1.106 1.085 2.1	1.102 1.085 1.7	0.367 0.361 0.6
L	0.369 0.372 -0.3	1.064 1.066 -0.2	1.275 1.312 -3.7	1.193 1.207 -1.5	1.351 1.354 -0.3	1.170 1.164 0.6	1.303 1.293 1.0	1.092 1.078 1.5	1.307 1.285 2.3	1.170 1.152 1.8	1.345 1.344 0.1	1.192 1.177 1.5	1.276 1.264 1.2	1.066 1.053 1.2	0.372 0.367 0.5
M		0.682 0.687 -0.4	1.007 1.017 -1.0	1.301 1.318 -1.7	1.183 1.191 -0.8	1.345 1.350 -0.5	1.095 1.091 0.3	1.047 1.038 1.0	1.095 1.072 2.3	1.350 1.327 2.3	1.183 1.174 0.9	1.302 1.292 1.0	1.010 1.001 0.8	0.684 0.677 0.7	
N		0.398 0.403 -0.4	1.027 1.043 -1.6	1.062 1.085 -2.2	1.302 1.316 -1.5	1.192 1.207 -1.5	1.309 1.319 -1.1	1.050 1.053 -0.3	1.307 1.300 0.7	1.192 1.189 0.4	1.301 1.299 0.3	1.062 1.059 0.4	1.027 1.022 0.5	0.399 0.396 0.3	
O			0.578 0.585 -0.8	1.027 1.040 -1.3	1.009 1.013 -0.3	1.276 1.313 -3.8	1.106 1.125 -1.9	1.251 1.266 -1.5	1.105 1.114 -0.9	1.274 1.294 -1.9	1.007 1.012 -0.5	1.027 1.028 -0.1	0.578 0.576 0.1		
P				0.399 0.404 -0.5	0.683 0.693 -1.0	1.066 1.093 -2.7	1.102 1.128 -2.6	0.900 0.915 -1.5	1.102 1.118 -1.6	1.064 1.082 -1.8	0.682 0.689 -0.7	0.398 0.400 -0.2			
R						0.372 0.384 -1.2	0.382 0.400 -1.9	0.366 0.375 -0.9	0.378 0.386 -0.8	0.369 0.384 -1.5					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.6

Figure T1 10.4.8-23: Plant T1 BOC 14 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.283 0.279 0.4	0.384 0.378 0.7	0.349 0.339 1.0	0.385 0.376 0.9	0.285 0.281 0.4					
B				0.413 0.408 0.5	0.645 0.638 0.7	1.147 1.135 1.3	1.233 1.214 1.9	0.946 0.911 3.4	1.235 1.204 3.1	1.151 1.141 1.0	0.647 0.646 0.1	0.413 0.416 -0.3			
C			0.554 0.547 0.7	1.130 1.117 1.3	1.017 1.008 0.9	1.240 1.232 0.7	1.013 0.992 2.1	1.316 1.275 4.1	1.015 0.981 3.4	1.245 1.251 -0.7	1.025 1.028 -0.3	1.134 1.149 -1.5	0.554 0.581 -2.8		
D		0.413 0.408 0.6	1.134 1.119 1.5	1.158 1.143 1.5	1.227 1.220 0.7	1.103 1.085 1.8	1.253 1.216 3.7	1.144 1.102 4.2	1.255 1.211 4.4	1.107 1.095 1.2	1.235 1.230 0.6	1.158 1.166 -0.9	1.130 1.153 -2.3	0.413 0.427 -1.5	
E		0.647 0.639 0.8	1.025 1.010 1.5	1.235 1.210 2.5	1.035 1.016 1.9	1.201 1.171 3.0	1.166 1.114 5.3	1.118 1.061 5.7	1.167 1.099 6.8	1.205 1.171 3.4	1.035 1.014 2.1	1.227 1.229 -0.3	1.017 1.030 -1.4	0.645 0.656 -1.1	
F	0.285 0.283 0.2	1.151 1.141 1.0	1.245 1.233 1.1	1.107 1.087 1.9	1.205 1.179 2.6	1.207 1.180 2.7	1.260 1.229 3.1	1.180 1.107 7.3	1.263 1.211 5.1	1.207 1.178 2.9	1.201 1.188 1.2	1.102 1.109 -0.7	1.239 1.261 -2.2	1.147 1.163 -1.6	0.283 0.287 -0.4
G	0.385 0.384 0.1	1.235 1.228 0.7	1.015 1.002 1.3	1.255 1.228 2.6	1.167 1.131 3.6	1.262 1.243 1.8	1.210 1.178 3.1	1.302 1.257 4.5	1.212 1.183 2.9	1.261 1.243 1.8	1.166 1.161 0.6	1.252 1.254 -0.2	1.012 1.008 0.4	1.232 1.244 -1.1	0.384 0.389 -0.4
H	0.349 0.352 -0.3	0.946 0.937 0.9	1.316 1.298 1.8	1.144 1.116 2.8	1.117 1.073 4.4	1.180 1.149 3.1	1.302 1.271 3.1	1.014 0.984 3.1	1.307 1.306 0.1	1.182 1.175 0.7	1.118 1.111 0.7	1.141 1.148 -0.7	1.315 1.338 -2.4	0.945 0.961 -1.6	0.348 0.355 -0.6
K	0.385 0.382 0.2	1.233 1.221 1.2	1.013 1.003 1.0	1.253 1.224 2.9	1.166 1.110 5.7	1.260 1.228 3.2	1.211 1.190 2.1	1.307 1.293 1.4	1.214 1.212 0.2	1.264 1.264 -0.1	1.167 1.147 2.0	1.254 1.266 -1.3	1.014 1.036 -2.2	1.234 1.264 -3.0	0.385 0.394 -0.9
L	0.283 0.280 0.3	1.147 1.134 1.3	1.240 1.249 -0.9	1.103 1.093 1.0	1.201 1.179 2.2	1.207 1.192 1.5	1.263 1.255 0.8	1.182 1.181 0.1	1.261 1.274 -1.3	1.208 1.235 -2.7	1.205 1.260 -5.5	1.106 1.144 -3.7	1.244 1.288 -4.4	1.150 1.189 -3.8	0.285 0.293 -0.9
M		0.645 0.641 0.4	1.017 1.014 0.3	1.227 1.224 0.2	1.035 1.029 0.6	1.205 1.203 0.1	1.167 1.171 -0.4	1.117 1.127 -1.0	1.167 1.188 -2.1	1.201 1.245 -4.4	1.035 1.080 -4.6	1.235 1.289 -5.4	1.025 1.069 -4.4	0.647 0.678 -3.1	
N		0.413 0.412 0.1	1.130 1.131 -0.1	1.158 1.165 -0.8	1.235 1.234 0.1	1.106 1.114 -0.8	1.254 1.269 -1.5	1.141 1.161 -2.0	1.252 1.297 -4.5	1.102 1.152 -4.9	1.227 1.288 -6.1	1.157 1.219 -6.1	1.134 1.191 -5.7	0.413 0.434 -2.0	
O			0.554 0.553 0.1	1.134 1.130 0.4	1.025 1.008 1.7	1.244 1.264 -2.0	1.014 1.035 -2.0	1.315 1.351 -3.6	1.012 1.053 -4.1	1.239 1.307 -6.8	1.017 1.075 -5.8	1.129 1.206 -7.7	0.554 0.586 -3.3		
P				0.413 0.413 0.0	0.647 0.650 -0.3	1.151 1.181 -3.0	1.234 1.264 -3.0	0.945 0.974 -2.9	1.232 1.286 -5.4	1.147 1.211 -6.4	0.645 0.682 -3.7	0.413 0.439 -2.6			
R						0.285 0.291 -0.6	0.385 0.390 -0.5	0.349 0.360 -1.1	0.384 0.404 -2.0	0.283 0.313 -3.0					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.7

Figure T1 10.4.8-24: Plant T1 MOC 14 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.298 0.300 -0.2	0.393 0.393 0.0	0.357 0.352 0.4	0.393 0.393 0.0	0.299 0.302 -0.3					
B				0.417 0.419 -0.3	0.638 0.643 -0.5	1.132 1.142 -1.0	1.186 1.189 -0.3	0.884 0.866 1.8	1.187 1.187 0.0	1.133 1.149 -1.6	0.638 0.646 -0.8	0.416 0.420 -0.4			
C			0.540 0.541 -0.2	1.094 1.100 -0.6	0.976 0.985 -0.9	1.314 1.334 -2.0	0.983 0.985 -0.2	1.325 1.319 0.7	0.984 0.986 -0.2	1.316 1.352 -3.6	0.980 0.993 -1.3	1.095 1.105 -0.9	0.540 0.543 -0.4		
D		0.417 0.418 -0.1	1.096 1.097 -0.2	1.085 1.087 -0.2	1.321 1.333 -1.2	1.095 1.100 -0.5	1.313 1.309 0.4	1.064 1.058 0.7	1.314 1.310 0.4	1.097 1.108 -1.1	1.327 1.331 -0.4	1.085 1.090 -0.4	1.094 1.098 -0.4	0.417 0.414 0.2	
E		0.639 0.642 -0.3	0.981 0.980 0.0	1.327 1.312 1.5	1.054 1.052 0.1	1.308 1.307 0.0	1.102 1.086 1.6	1.023 1.005 1.8	1.102 1.081 2.1	1.311 1.300 1.1	1.054 1.039 1.5	1.321 1.320 0.1	0.976 0.980 -0.4	0.638 0.640 -0.2	
F	0.299 0.303 -0.4	1.133 1.146 -1.3	1.316 1.325 -1.0	1.097 1.096 0.1	1.311 1.311 -0.1	1.176 1.185 -0.9	1.338 1.356 -1.8	1.108 1.075 3.3	1.339 1.317 2.3	1.176 1.163 1.3	1.308 1.297 1.0	1.095 1.096 -0.1	1.314 1.329 -1.6	1.132 1.139 -0.7	0.298 0.299 -0.1
G	0.393 0.401 -0.8	1.187 1.209 -2.3	0.984 0.991 -0.7	1.314 1.314 0.0	1.102 1.097 0.5	1.339 1.363 -2.4	1.161 1.164 -0.2	1.377 1.358 1.9	1.162 1.151 1.1	1.338 1.326 1.2	1.102 1.093 0.9	1.313 1.306 0.7	0.983 0.978 0.5	1.186 1.188 -0.1	0.393 0.394 0.0
H	0.357 0.370 -1.3	0.884 0.896 -1.2	1.325 1.335 -1.0	1.064 1.062 0.2	1.022 1.005 1.7	1.108 1.104 0.4	1.377 1.367 1.0	1.017 0.996 2.1	1.380 1.382 -0.2	1.109 1.100 1.0	1.023 1.006 1.7	1.063 1.053 1.0	1.325 1.330 -0.5	0.884 0.885 -0.1	0.357 0.357 0.0
K	0.393 0.398 -0.5	1.186 1.196 -0.9	0.983 0.994 -1.0	1.313 1.308 0.6	1.102 1.070 3.2	1.338 1.324 1.4	1.162 1.151 1.1	1.380 1.364 1.6	1.164 1.155 0.9	1.340 1.324 1.6	1.102 1.059 4.2	1.313 1.284 2.9	0.984 0.980 0.4	1.187 1.186 0.0	0.393 0.393 0.0
L	0.298 0.299 -0.1	1.132 1.132 0.0	1.314 1.356 -4.2	1.095 1.101 -0.6	1.308 1.298 1.0	1.176 1.174 0.2	1.340 1.329 1.1	1.109 1.097 1.2	1.338 1.328 1.0	1.176 1.183 -0.6	1.311 1.353 -4.2	1.097 1.103 -0.6	1.316 1.324 -0.8	1.133 1.134 -0.1	0.299 0.299 0.0
M		0.638 0.639 -0.1	0.976 0.978 -0.2	1.321 1.323 -0.2	1.054 1.048 0.6	1.311 1.303 0.7	1.102 1.089 1.3	1.022 1.006 1.6	1.102 1.081 2.1	1.308 1.322 -1.4	1.054 1.070 -1.6	1.327 1.338 -1.1	0.980 0.985 -0.4	0.638 0.633 0.5	
N		0.417 0.417 0.0	1.094 1.095 -0.1	1.085 1.089 -0.4	1.327 1.316 1.1	1.097 1.092 0.5	1.313 1.300 1.3	1.062 1.039 2.3	1.313 1.316 -0.3	1.095 1.107 -1.2	1.321 1.336 -1.5	1.085 1.093 -0.8	1.095 1.100 -0.5	0.416 0.416 0.0	
O			0.540 0.537 0.2	1.095 1.085 1.1	0.980 0.953 2.7	1.316 1.322 -0.6	0.984 0.983 0.2	1.325 1.321 0.4	0.983 0.991 -0.7	1.314 1.342 -2.8	0.976 0.988 -1.2	1.094 1.096 -0.2	0.540 0.541 -0.2		
P				0.416 0.412 0.4	0.638 0.632 0.6	1.133 1.142 -0.8	1.187 1.193 -0.6	0.884 0.888 -0.4	1.186 1.200 -1.4	1.132 1.153 -2.1	0.638 0.647 -0.9	0.417 0.419 -0.2			
R						0.299 0.302 -0.3	0.393 0.399 -0.6	0.357 0.360 -0.3	0.393 0.399 -0.6	0.298 0.311 -1.3					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.2

Figure T1 10.4.8-25: Plant T1 EOC 14 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.353 0.355 -0.2	0.456 0.454 0.1	0.423 0.418 0.4	0.456 0.456 -0.1	0.354 0.358 -0.4					
B				0.492 0.498 -0.6	0.702 0.710 -0.8	1.125 1.134 -1.0	1.163 1.160 0.3	0.891 0.873 1.8	1.163 1.167 -0.4	1.124 1.142 -1.8	0.701 0.710 -0.9	0.491 0.495 -0.4			
C			0.605 0.612 -0.6	1.113 1.126 -1.3	0.992 1.007 -1.6	1.320 1.344 -2.4	0.977 0.982 -0.5	1.263 1.263 0.1	0.977 0.988 -1.1	1.320 1.359 -3.9	0.994 1.007 -1.3	1.113 1.118 -0.5	0.605 0.601 0.4		
D		0.491 0.496 -0.5	1.113 1.123 -1.0	1.074 1.084 -1.0	1.328 1.353 -2.5	1.151 1.167 -1.5	1.274 1.280 -0.6	1.021 1.021 0.0	1.273 1.275 -0.1	1.151 1.160 -0.8	1.330 1.335 -0.4	1.074 1.076 -0.1	1.113 1.110 0.3	0.492 0.483 1.0	
E		0.701 0.710 -0.9	0.994 1.001 -0.7	1.331 1.325 0.5	1.074 1.082 -0.9	1.347 1.361 -1.4	1.062 1.063 -0.1	0.983 0.974 0.9	1.061 1.047 1.4	1.348 1.341 0.7	1.074 1.066 0.8	1.328 1.327 0.2	0.992 0.996 -0.5	0.702 0.704 -0.2	
F	0.354 0.361 -0.7	1.124 1.145 -2.1	1.320 1.340 -2.0	1.151 1.159 -0.8	1.348 1.361 -1.3	1.129 1.149 -1.9	1.266 1.301 -3.5	1.024 0.999 2.5	1.266 1.248 1.9	1.129 1.119 1.1	1.347 1.338 0.9	1.151 1.148 0.3	1.320 1.343 -2.3	1.125 1.137 -1.2	0.353 0.357 -0.3
G	0.456 0.467 -1.2	1.163 1.192 -2.9	0.977 0.990 -1.3	1.273 1.281 -0.8	1.061 1.067 -0.5	1.267 1.295 -2.9	1.051 1.059 -0.8	1.232 1.216 1.6	1.051 1.038 1.3	1.266 1.253 1.3	1.062 1.054 0.8	1.274 1.271 0.3	0.977 0.990 -1.2	1.164 1.173 -1.0	0.456 0.459 -0.3
H	0.423 0.437 -1.4	0.891 0.904 -1.3	1.264 1.274 -1.1	1.021 1.020 0.0	0.982 0.969 1.4	1.024 1.023 0.1	1.232 1.224 0.8	0.932 0.910 2.2	1.233 1.226 0.7	1.025 1.012 1.3	0.983 0.966 1.7	1.020 1.009 1.0	1.263 1.265 -0.1	0.891 0.892 -0.1	0.423 0.423 0.0
K	0.456 0.460 -0.4	1.163 1.167 -0.3	0.977 0.985 -0.7	1.274 1.266 0.8	1.062 1.027 3.4	1.266 1.251 1.5	1.051 1.041 1.1	1.233 1.215 1.8	1.051 1.038 1.3	1.266 1.245 2.1	1.061 1.020 4.1	1.273 1.242 3.1	0.977 0.969 0.8	1.163 1.157 0.6	0.456 0.454 0.2
L	0.353 0.351 0.2	1.125 1.111 1.4	1.320 1.353 -3.2	1.151 1.152 -0.1	1.347 1.334 1.3	1.129 1.126 0.3	1.266 1.257 1.0	1.024 1.012 1.3	1.266 1.249 1.7	1.129 1.126 0.3	1.348 1.379 -3.1	1.151 1.150 0.2	1.320 1.316 0.4	1.124 1.116 0.9	0.354 0.352 0.2
M		0.702 0.694 0.8	0.992 0.982 1.0	1.328 1.321 0.8	1.074 1.066 0.8	1.348 1.342 0.6	1.061 1.054 0.7	0.982 0.968 1.4	1.062 1.034 2.7	1.347 1.338 0.9	1.074 1.077 -0.4	1.331 1.327 0.4	0.994 0.986 0.7	0.701 0.685 1.6	
N		0.492 0.487 0.5	1.113 1.103 1.0	1.074 1.067 0.7	1.331 1.319 1.2	1.151 1.150 0.1	1.273 1.268 0.5	1.020 1.006 1.3	1.274 1.271 0.3	1.151 1.154 -0.3	1.328 1.329 0.0	1.074 1.068 0.7	1.113 1.103 1.0	0.491 0.484 0.7	
O			0.605 0.599 0.6	1.113 1.099 1.4	0.994 0.972 2.2	1.320 1.337 -1.7	0.977 0.981 -0.4	1.263 1.264 -0.1	0.977 0.983 -0.6	1.320 1.343 -2.3	0.992 0.993 -0.2	1.113 1.095 1.8	0.605 0.598 0.8		
P				0.491 0.487 0.4	0.701 0.699 0.2	1.124 1.143 -1.9	1.163 1.172 -0.9	0.891 0.896 -0.5	1.164 1.174 -1.1	1.125 1.140 -1.5	0.702 0.705 -0.3	0.492 0.488 0.4			
R						0.354 0.358 -0.4	0.456 0.455 0.1	0.423 0.425 -0.2	0.456 0.462 -0.5	0.353 0.364 -1.1					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.3

Figure T1 10.4.8-26: Plant T1 BOC 15 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.245 0.241 0.4	0.321 0.311 1.0	0.269 0.254 1.5	0.319 0.309 1.0	0.244 0.240 0.3					
B				0.426 0.422 0.4	0.556 0.551 0.5	1.068 1.054 1.5	1.112 1.081 3.0	0.678 0.623 5.4	1.104 1.069 3.4	1.063 1.054 1.0	0.553 0.552 0.1	0.424 0.424 0.0		Calculated power Measured power Difference (C-M)*100	
C			0.575 0.568 0.7	1.118 1.106 1.2	1.196 1.188 0.8	1.255 1.252 0.3	1.177 1.153 2.4	1.254 1.213 4.0	1.172 1.146 2.5	1.251 1.262 -1.1	1.191 1.193 -0.3	1.113 1.114 -0.1	0.575 0.577 -0.2		
D		0.424 0.417 0.7	1.113 1.096 1.7	1.162 1.146 1.5	1.184 1.179 0.5	1.125 1.114 1.1	1.294 1.267 2.8	1.151 1.122 2.9	1.293 1.267 2.6	1.123 1.120 0.3	1.180 1.178 0.2	1.162 1.160 0.1	1.118 1.118 0.0	0.426 0.424 0.2	
E		0.554 0.545 0.9	1.191 1.169 2.2	1.180 1.154 2.6	1.314 1.298 1.6	1.268 1.253 1.5	1.192 1.158 3.4	1.200 1.167 3.3	1.193 1.160 3.3	1.269 1.255 1.4	1.314 1.307 0.7	1.184 1.181 0.3	1.196 1.199 -0.3	0.556 0.557 -0.1	
F	0.244 0.241 0.3	1.064 1.051 1.3	1.251 1.227 2.4	1.123 1.107 1.7	1.270 1.258 1.2	1.312 1.312 -0.1	1.306 1.320 -1.4	1.156 1.122 3.4	1.310 1.281 2.9	1.311 1.298 1.3	1.268 1.264 0.4	1.125 1.119 0.6	1.255 1.266 -1.1	1.068 1.072 -0.4	0.245 0.246 -0.1
G	0.319 0.318 0.2	1.105 1.103 0.3	1.173 1.161 1.1	1.293 1.278 1.5	1.194 1.178 1.6	1.311 1.328 -1.7	1.033 1.030 0.3	1.254 1.226 2.8	1.032 1.010 2.2	1.306 1.301 0.5	1.193 1.202 -1.0	1.294 1.295 0.0	1.177 1.168 1.0	1.112 1.111 0.1	0.321 0.321 0.0
H	0.270 0.267 0.3	0.676 0.674 0.2	1.255 1.250 0.5	1.152 1.142 1.0	1.201 1.191 1.0	1.158 1.152 0.6	1.258 1.241 1.7	0.915 0.881 3.4	1.254 1.278 -2.4	1.157 1.166 -0.9	1.201 1.206 -0.5	1.151 1.159 -0.8	1.254 1.260 -0.6	0.678 0.682 -0.4	0.269 0.271 -0.2
K	0.321 0.320 0.1	1.113 1.112 0.1	1.178 1.184 -0.5	1.295 1.285 1.0	1.194 1.154 4.0	1.308 1.290 1.7	1.035 1.023 1.2	1.258 1.245 1.3	1.034 1.041 -0.8	1.311 1.324 -1.3	1.194 1.188 0.6	1.293 1.316 -2.3	1.172 1.187 -1.5	1.104 1.116 -1.2	0.319 0.322 -0.3
L	0.245 0.244 0.1	1.069 1.065 0.5	1.256 1.295 -3.9	1.126 1.133 -0.7	1.269 1.259 1.1	1.313 1.309 0.4	1.312 1.298 1.4	1.159 1.153 0.6	1.307 1.321 -1.4	1.312 1.351 -3.9	1.270 1.348 -7.8	1.123 1.160 -3.7	1.251 1.271 -2.0	1.064 1.078 -1.4	0.244 0.247 -0.3
M		0.557 0.563 -0.7	1.197 1.228 -3.1	1.184 1.193 -0.9	1.315 1.309 0.5	1.270 1.258 1.3	1.194 1.167 2.8	1.201 1.190 1.2	1.194 1.204 -1.0	1.269 1.315 -4.6	1.314 1.372 -5.7	1.181 1.223 -4.2	1.191 1.222 -3.1	0.554 0.561 -0.7	
N		0.427 0.432 -0.5	1.119 1.133 -1.5	1.162 1.166 -0.3	1.181 1.176 0.5	1.123 1.112 1.2	1.293 1.274 2.0	1.152 1.129 2.3	1.295 1.324 -2.9	1.126 1.166 -4.0	1.184 1.232 -4.8	1.162 1.207 -4.5	1.113 1.150 -3.6	0.424 0.435 -1.1	
O			0.575 0.579 -0.4	1.113 1.114 -0.1	1.191 1.186 0.5	1.251 1.233 1.8	1.172 1.164 0.8	1.254 1.255 -0.1	1.178 1.205 -2.7	1.256 1.309 -5.3	1.196 1.248 -5.1	1.118 1.171 -5.3	0.575 0.599 -2.3		
P				0.424 0.424 0.0	0.554 0.552 0.2	1.064 1.059 0.5	1.104 1.108 -0.4	0.678 0.686 -0.8	1.112 1.141 -2.9	1.069 1.109 -4.0	0.556 0.579 -2.3	0.426 0.446 -1.9			
R						0.244 0.246 -0.2	0.319 0.337 -1.8	0.270 0.277 -0.8	0.321 0.331 -1.0	0.245 0.259 -1.4					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 2.1

Figure T1 10.4.8-27: Plant T1 MOC 15 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.289 0.291 -0.3	0.371 0.370 0.1	0.316 0.309 0.7	0.370 0.370 0.0	0.289 0.293 -0.4					
B				0.470 0.474 -0.4	0.619 0.627 -0.8	1.162 1.178 -1.6	1.181 1.180 0.1	0.725 0.695 3.0	1.177 1.178 -0.1	1.161 1.185 -2.4	0.618 0.630 -1.1	0.469 0.474 -0.5			
C			0.593 0.592 0.1	1.143 1.150 -0.6	1.299 1.317 -1.8	1.369 1.406 -3.7	1.152 1.160 -0.7	1.326 1.322 0.4	1.150 1.159 -1.0	1.367 1.419 -5.2	1.297 1.323 -2.6	1.141 1.149 -0.8	0.593 0.580 1.2		
D		0.469 0.464 0.5	1.141 1.133 0.8	1.076 1.073 0.4	1.096 1.104 -0.8	1.059 1.070 -1.0	1.310 1.313 -0.3	1.064 1.063 0.1	1.310 1.314 -0.4	1.059 1.074 -1.5	1.094 1.106 -1.2	1.077 1.081 -0.4	1.143 1.138 0.5	0.470 0.455 1.6	
E		0.618 0.608 1.0	1.297 1.282 1.5	1.094 1.071 2.3	1.272 1.268 0.3	1.110 1.114 -0.3	1.061 1.051 0.9	1.064 1.053 1.1	1.061 1.051 1.0	1.111 1.111 0.0	1.272 1.277 -0.6	1.096 1.098 -0.3	1.299 1.306 -0.8	0.619 0.620 -0.1	
F	0.288 0.281 0.8	1.161 1.135 2.6	1.367 1.357 1.0	1.058 1.047 1.1	1.111 1.109 0.2	1.154 1.171 -1.7	1.303 1.341 -3.8	1.079 1.057 2.2	1.306 1.284 2.2	1.154 1.145 0.9	1.110 1.108 0.3	1.059 1.054 0.5	1.369 1.394 -2.6	1.162 1.174 -1.2	0.289 0.291 -0.2
G	0.370 0.357 1.3	1.177 1.125 5.1	1.149 1.130 2.0	1.309 1.295 1.4	1.061 1.050 1.1	1.307 1.340 -3.4	1.022 1.028 -0.6	1.344 1.318 2.6	1.021 0.988 3.3	1.303 1.289 1.4	1.061 1.060 0.1	1.310 1.309 0.1	1.152 1.150 0.2	1.181 1.186 -0.5	0.371 0.373 -0.2
H	0.316 0.315 0.2	0.720 0.707 1.3	1.326 1.315 1.0	1.064 1.056 0.8	1.064 1.057 0.7	1.080 1.080 0.0	1.347 1.335 1.2	0.961 0.929 3.3	1.344 1.361 -1.7	1.080 1.075 0.5	1.064 1.054 1.0	1.064 1.067 -0.3	1.326 1.342 -1.6	0.725 0.728 -0.3	0.316 0.317 -0.1
K	0.371 0.368 0.3	1.180 1.172 0.8	1.152 1.160 -0.7	1.310 1.304 0.6	1.061 1.027 3.4	1.304 1.292 1.2	1.023 1.012 1.1	1.347 1.327 2.0	1.022 1.017 0.5	1.307 1.293 1.3	1.062 1.024 3.8	1.309 1.317 -0.8	1.150 1.151 -0.2	1.177 1.173 0.4	0.370 0.369 0.1
L	0.289 0.285 0.4	1.162 1.146 1.6	1.368 1.429 -6.1	1.059 1.072 -1.3	1.110 1.106 0.5	1.154 1.156 -0.1	1.307 1.296 1.1	1.080 1.068 1.2	1.304 1.293 1.1	1.154 1.157 -0.3	1.111 1.148 -3.7	1.059 1.065 -0.6	1.367 1.356 1.1	1.161 1.147 1.4	0.288 0.286 0.3
M		0.619 0.624 -0.5	1.299 1.332 -3.3	1.096 1.107 -1.1	1.271 1.273 -0.2	1.111 1.108 0.3	1.061 1.044 1.7	1.064 1.050 1.4	1.061 1.039 2.1	1.110 1.110 0.0	1.272 1.284 -1.2	1.094 1.093 0.1	1.297 1.282 1.5	0.618 0.593 2.5	
N		0.470 0.476 -0.5	1.143 1.159 -1.6	1.076 1.079 -0.3	1.094 1.095 -0.2	1.058 1.059 -0.1	1.309 1.305 0.4	1.064 1.058 0.6	1.310 1.332 -2.3	1.059 1.071 -1.2	1.096 1.101 -0.5	1.076 1.071 0.6	1.141 1.128 1.3	0.469 0.459 1.0	
O			0.593 0.597 -0.5	1.141 1.145 -0.4	1.297 1.299 -0.2	1.367 1.379 -1.2	1.150 1.157 -0.7	1.326 1.335 -0.9	1.152 1.169 -1.7	1.368 1.396 -2.8	1.299 1.305 -0.6	1.143 1.126 1.7	0.593 0.584 0.8		
P				0.469 0.471 -0.2	0.618 0.621 -0.2	1.161 1.169 -0.8	1.177 1.195 -1.8	0.725 0.734 -1.0	1.180 1.198 -1.8	1.162 1.180 -1.8	0.619 0.624 -0.4	0.470 0.467 0.4			
R						0.288 0.295 -0.7	0.370 0.398 -2.7	0.316 0.326 -0.9	0.371 0.377 -0.6	0.289 0.291 -0.3					

Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.5

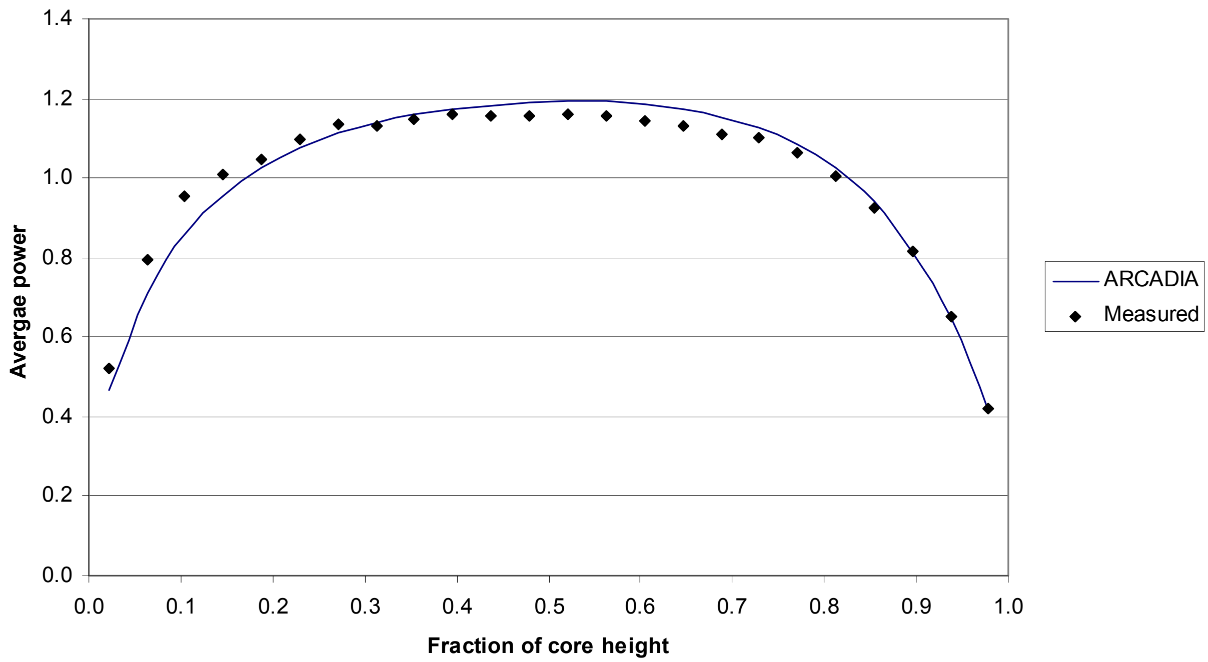
Figure T1 10.4.8-28: Plant T1 EOC 15 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						0.342 0.343 -0.1	0.439 0.434 0.5	0.391 0.382 0.9	0.439 0.437 0.2	0.342 0.345 -0.3					
B				0.542 0.549 -0.6	0.672 0.682 -1.0	1.142 1.154 -1.2	1.168 1.155 1.2	0.775 0.744 3.1	1.167 1.166 0.1	1.143 1.159 -1.6	0.672 0.679 -0.6	0.542 0.541 0.0			
C			0.656 0.659 -0.3	1.143 1.156 -1.2	1.293 1.318 -2.4	1.319 1.357 -3.8	1.114 1.121 -0.7	1.310 1.308 0.2	1.113 1.124 -1.2	1.319 1.360 -4.1	1.293 1.306 -1.3	1.142 1.135 0.7	0.656 0.629 2.7		
D		0.542 0.540 0.2	1.142 1.141 0.1	1.061 1.065 -0.4	1.074 1.093 -1.9	1.037 1.054 -1.7	1.277 1.288 -1.1	1.034 1.038 -0.4	1.277 1.285 -0.8	1.037 1.053 -1.6	1.073 1.074 -0.1	1.061 1.052 0.9	1.143 1.120 2.4	0.542 0.512 3.1	
E		0.672 0.668 0.5	1.293 1.285 0.8	1.073 1.056 1.7	1.253 1.261 -0.8	1.084 1.099 -1.4	1.042 1.049 -0.7	1.049 1.048 0.1	1.042 1.036 0.6	1.085 1.081 0.4	1.253 1.240 1.3	1.074 1.065 0.9	1.293 1.286 0.7	0.673 0.665 0.8	
F	0.342 0.339 0.3	1.142 1.134 0.9	1.319 1.314 0.6	1.037 1.033 0.4	1.085 1.093 -0.8	1.120 1.148 -2.7	1.282 1.331 -4.9	1.065 1.054 1.0	1.283 1.263 2.0	1.120 1.107 1.3	1.085 1.076 0.9	1.037 1.030 0.7	1.319 1.334 -1.5	1.142 1.146 -0.4	0.342 0.343 -0.1
G	0.439 0.435 0.4	1.167 1.152 1.4	1.112 1.107 0.5	1.277 1.275 0.2	1.042 1.043 -0.1	1.283 1.331 -4.8	1.018 1.031 -1.3	1.337 1.315 2.2	1.018 0.978 4.0	1.282 1.262 2.0	1.042 1.040 0.2	1.277 1.275 0.2	1.114 1.120 -0.6	1.168 1.172 -0.4	0.439 0.440 -0.1
H	0.392 0.392 0.0	0.769 0.763 0.6	1.310 1.309 0.0	1.033 1.034 0.0	1.049 1.052 -0.3	1.065 1.072 -0.7	1.338 1.333 0.5	0.979 0.947 3.1	1.337 1.325 1.2	1.065 1.050 1.5	1.049 1.034 1.5	1.034 1.030 0.4	1.310 1.312 -0.2	0.775 0.774 0.1	0.391 0.390 0.1
K	0.439 0.434 0.5	1.168 1.154 1.4	1.113 1.122 -0.9	1.277 1.273 0.3	1.042 1.008 3.4	1.282 1.274 0.8	1.018 1.010 0.8	1.338 1.317 2.1	1.018 1.005 1.3	1.283 1.264 1.9	1.042 1.003 3.9	1.277 1.271 0.5	1.112 1.108 0.5	1.167 1.160 0.7	0.439 0.436 0.3
L	0.342 0.332 1.0	1.142 1.103 3.9	1.319 1.379 -6.1	1.037 1.049 -1.2	1.084 1.081 0.4	1.120 1.126 -0.6	1.283 1.277 0.6	1.065 1.052 1.3	1.282 1.268 1.4	1.120 1.123 -0.2	1.085 1.132 -4.7	1.037 1.044 -0.7	1.319 1.310 1.0	1.143 1.129 1.3	0.342 0.339 0.4
M		0.673 0.669 0.4	1.293 1.316 -2.3	1.074 1.080 -0.6	1.253 1.255 -0.2	1.085 1.086 -0.1	1.042 1.034 0.8	1.049 1.034 1.5	1.042 1.017 2.4	1.084 1.082 0.2	1.253 1.268 -1.5	1.073 1.074 -0.1	1.293 1.281 1.2	0.673 0.651 2.1	
N		0.542 0.543 0.0	1.143 1.149 -0.6	1.061 1.055 0.6	1.073 1.072 0.1	1.037 1.043 -0.6	1.277 1.277 0.0	1.034 1.021 1.3	1.277 1.289 -1.2	1.037 1.044 -0.7	1.074 1.079 -0.5	1.061 1.058 0.3	1.142 1.132 1.0	0.542 0.532 0.9	
O			0.656 0.656 -0.1	1.142 1.140 0.2	1.293 1.292 0.1	1.319 1.348 -2.9	1.112 1.126 -1.3	1.310 1.318 -0.8	1.114 1.125 -1.1	1.319 1.338 -1.9	1.293 1.298 -0.5	1.143 1.132 1.2	0.656 0.649 0.6		
P				0.542 0.541 0.1	0.672 0.673 -0.1	1.143 1.149 -0.6	1.167 1.192 -2.6	0.775 0.787 -1.2	1.168 1.182 -1.4	1.142 1.154 -1.2	0.672 0.676 -0.3	0.542 0.540 0.3			
R						0.342 0.353 -1.1	0.439 0.483 -4.4	0.391 0.406 -1.5	0.439 0.446 -0.7	0.342 0.341 0.0					

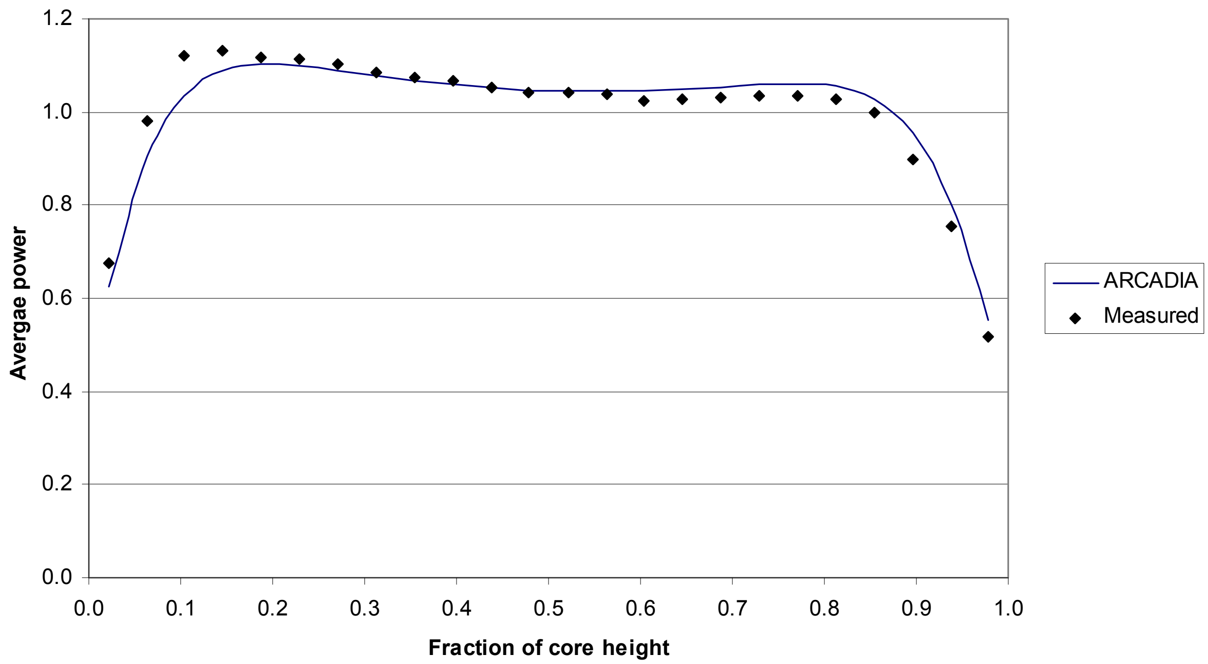
Calculated minus Measured Average Assembly Powers, RMS difference * 100 = 1.6

Figure T1 10.4.8-29: Plant T1 BOC 9 Core Average Axial Power Distribution



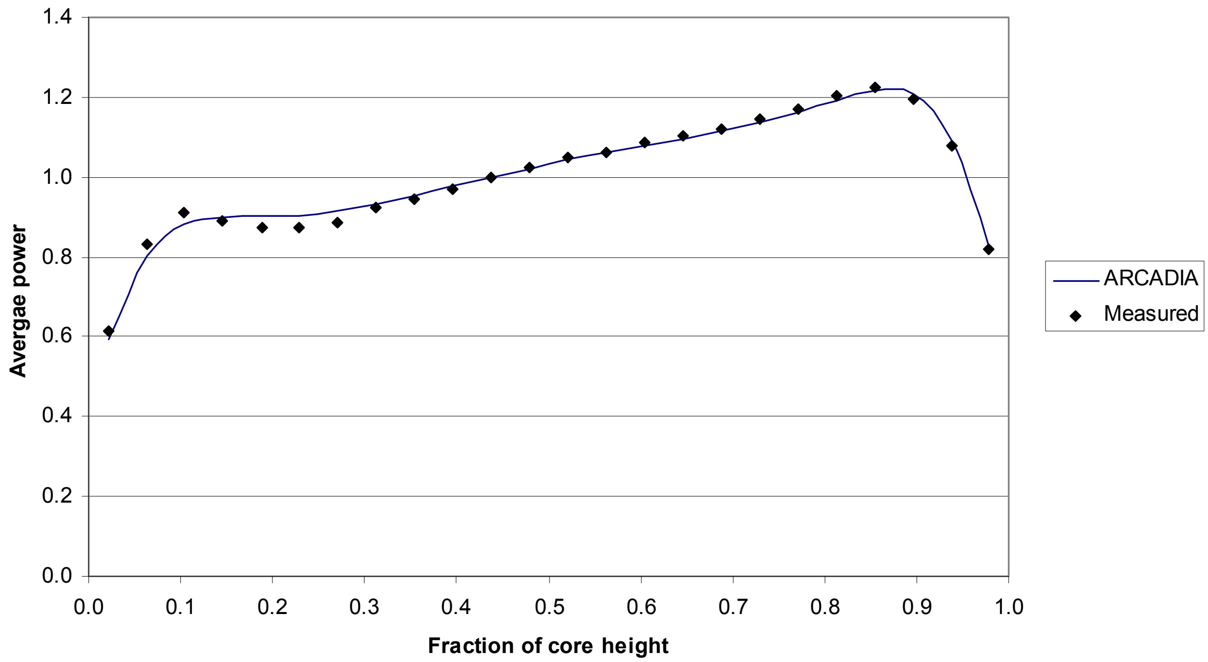
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.9

Figure T1 10.4.8-30: Plant T1 MOC 9 Core Average Axial Power Distribution



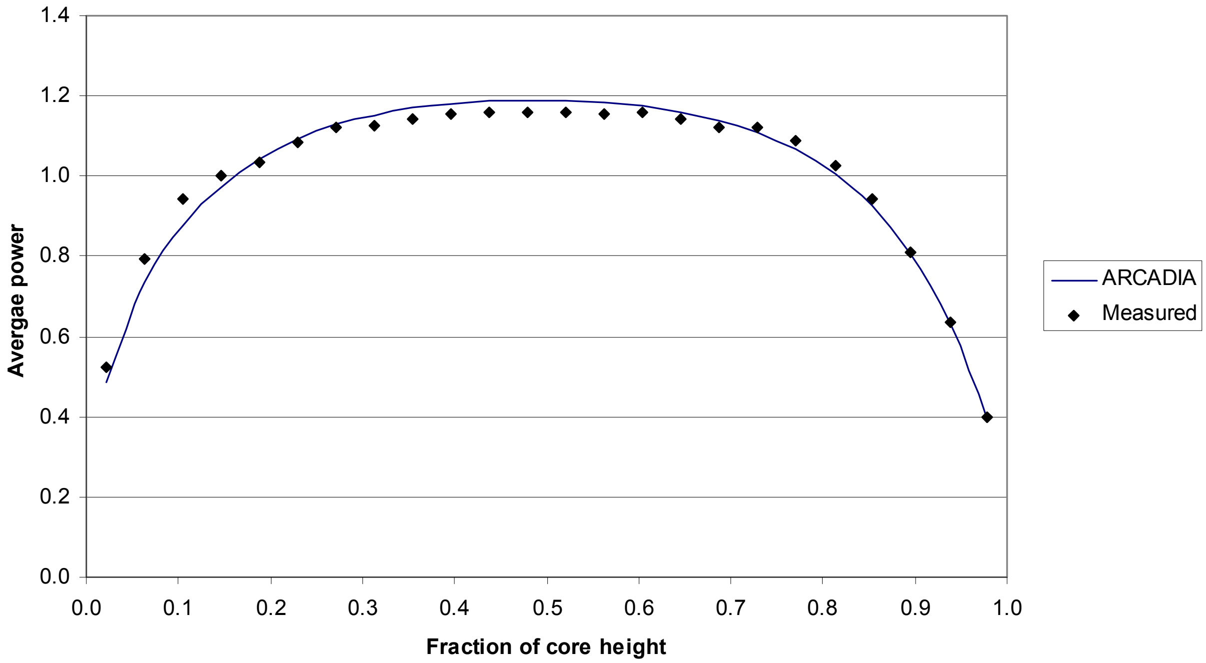
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.5

Figure T1 10.4.8-31: Plant T1 EOC 9 Core Average Axial Power Distribution



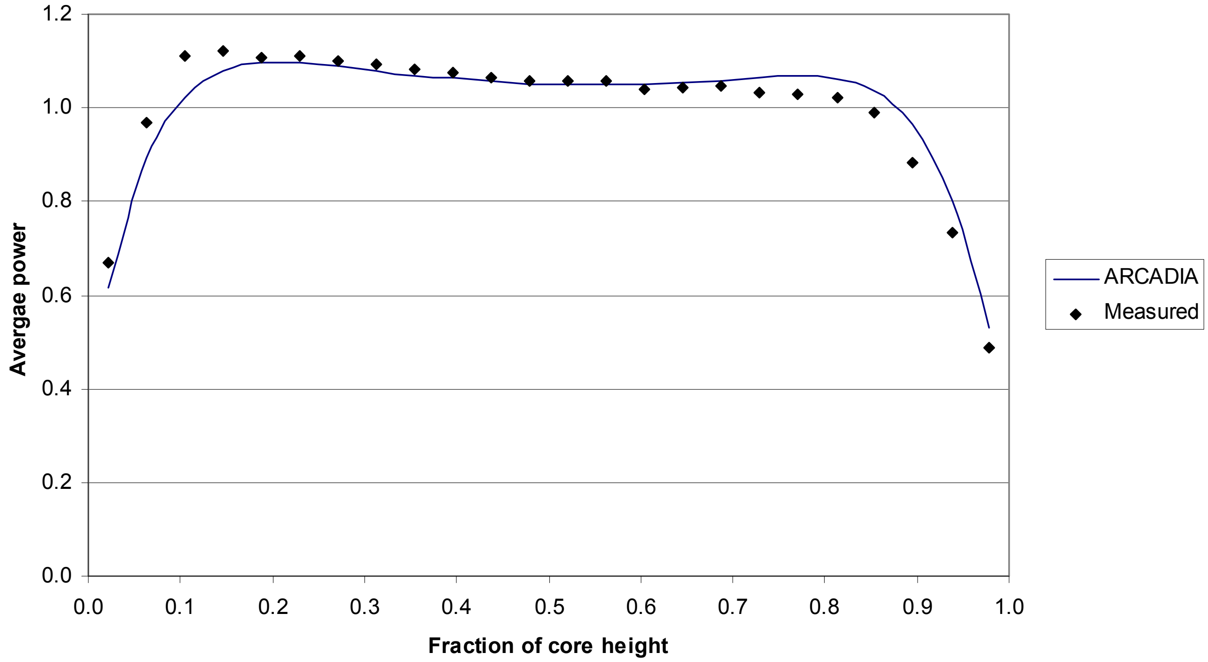
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 1.5

Figure T1 10.4.8-32: Plant T1 BOC 10 Core Average Axial Power Distribution



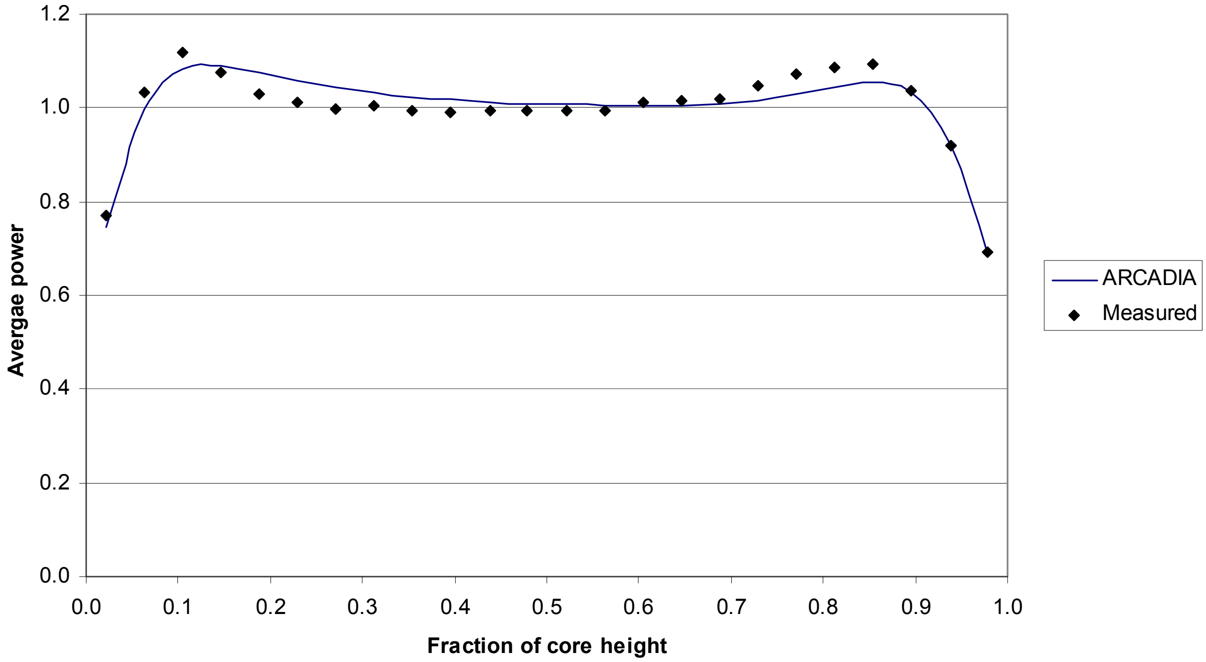
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.8

Figure T1 10.4.8-33: Plant T1 MOC 10 Core Average Axial Power Distribution



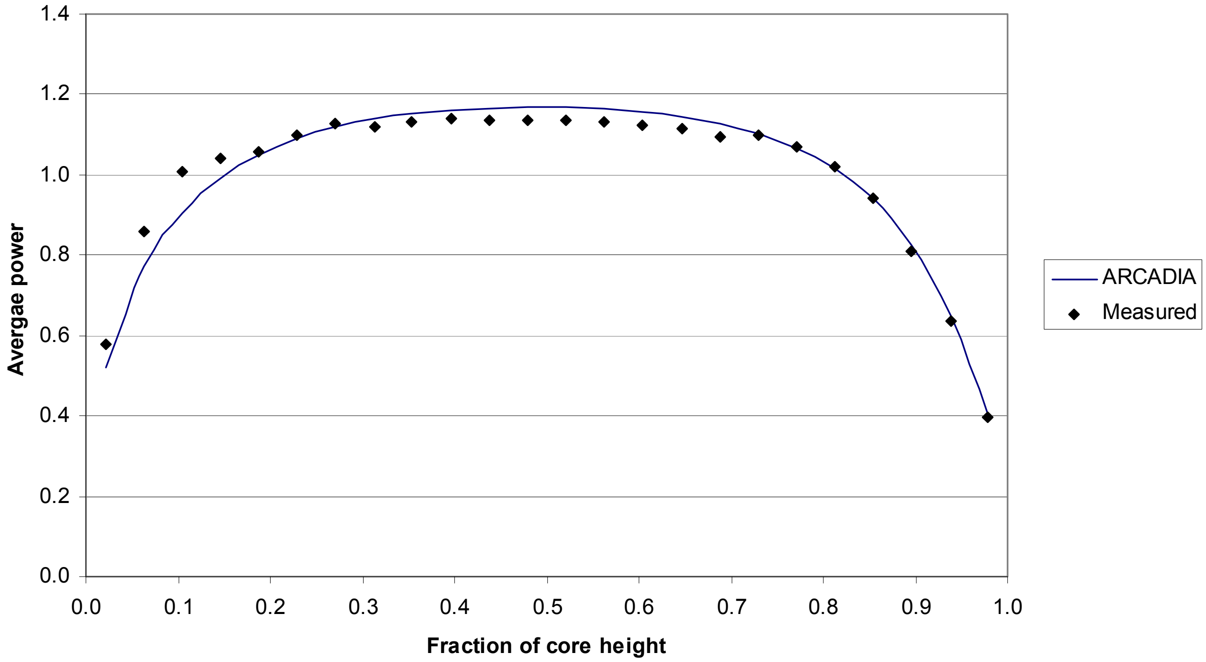
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 4.0

Figure T1 10.4.8-34: Plant T1 EOC 10 Core Average Axial Power Distribution



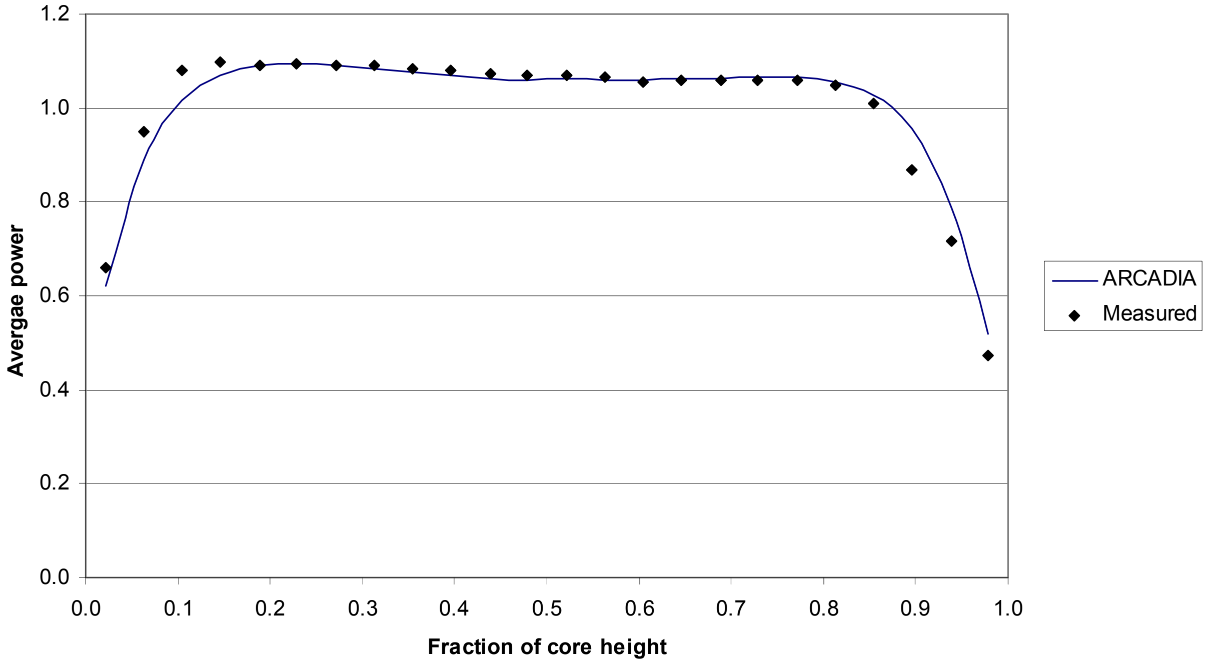
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.9

Figure T1 10.4.8-35: Plant T1 BOC 11 Core Average Axial Power Distribution



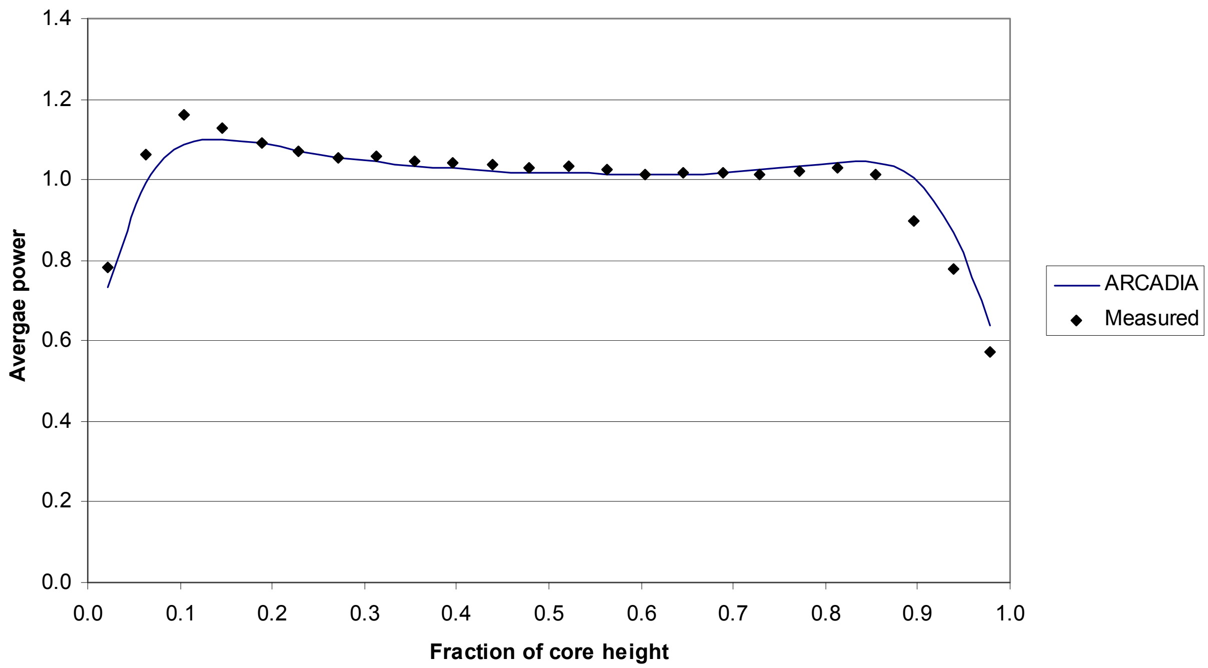
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.7

Figure T1 10.4.8-36: Plant T1 MOC 11 Core Average Axial Power Distribution



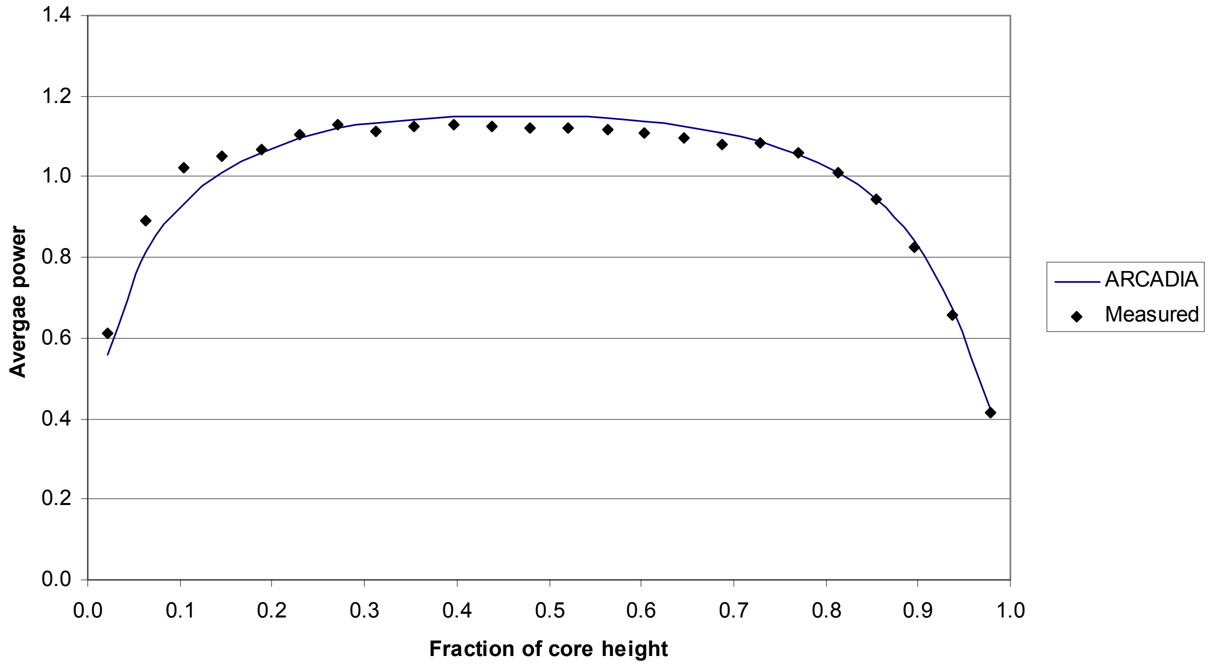
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.2

Figure T1 10.4.8-37: Plant T1 EOC 11 Core Average Axial Power Distribution



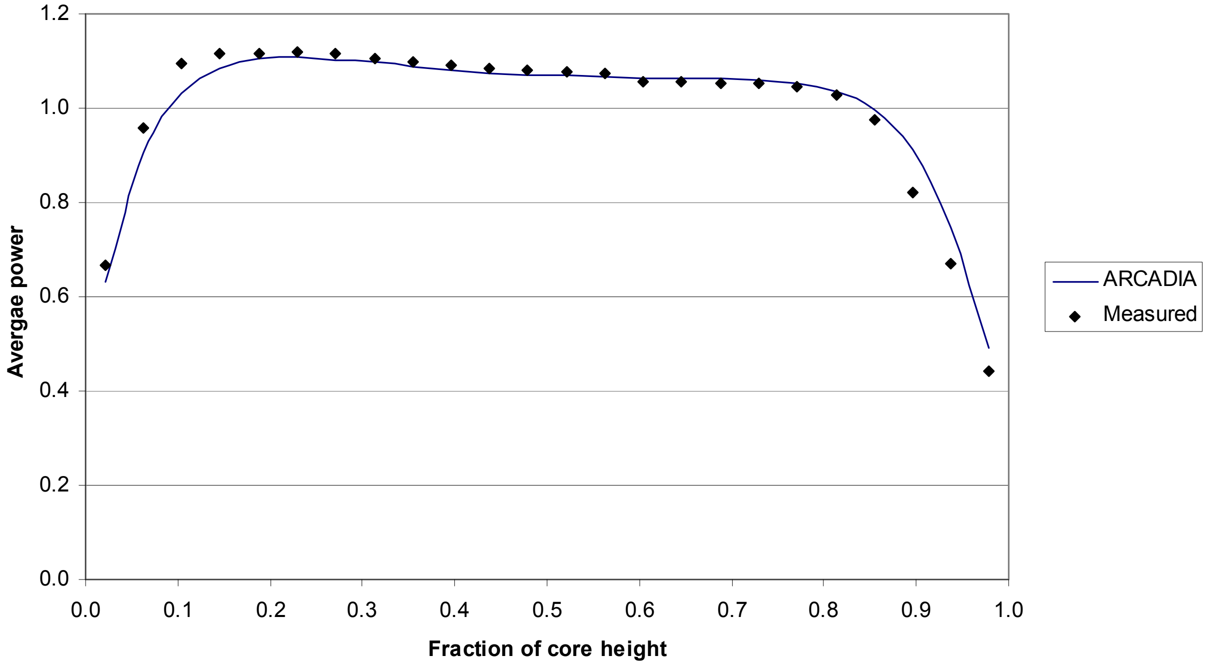
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 4.1

Figure T1 10.4.8-38: Plant T1 BOC 12 Core Average Axial Power Distribution



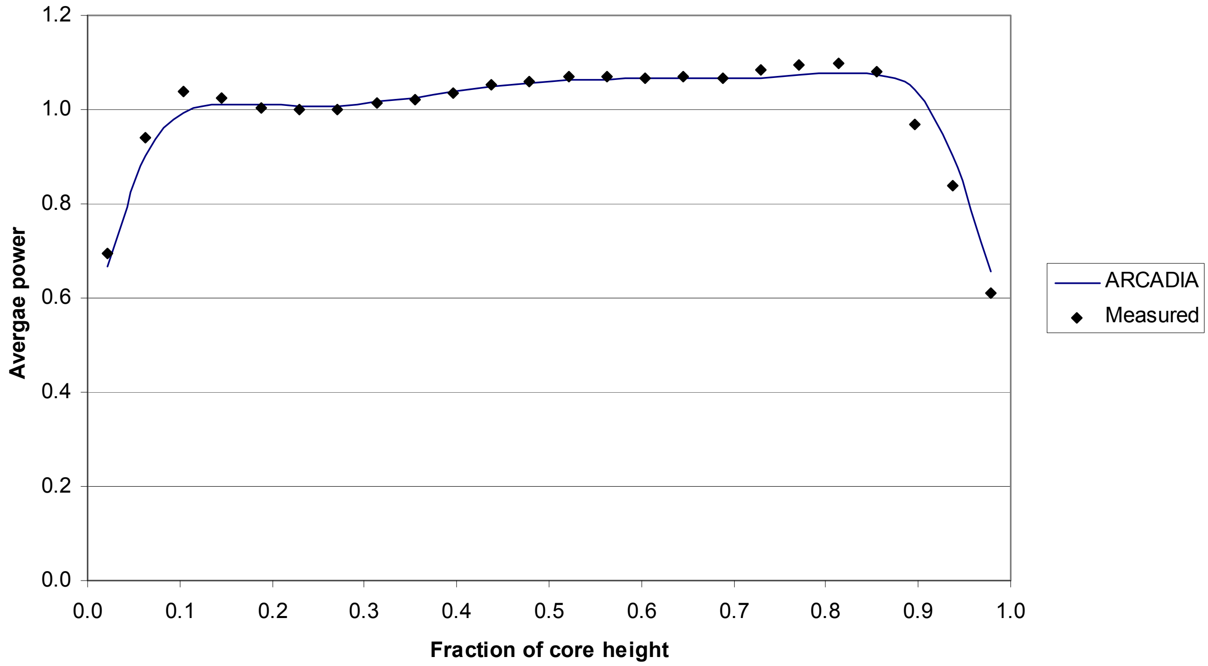
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.3

Figure T1 10.4.8-39: Plant T1 MOC 12 Core Average Axial Power Distribution



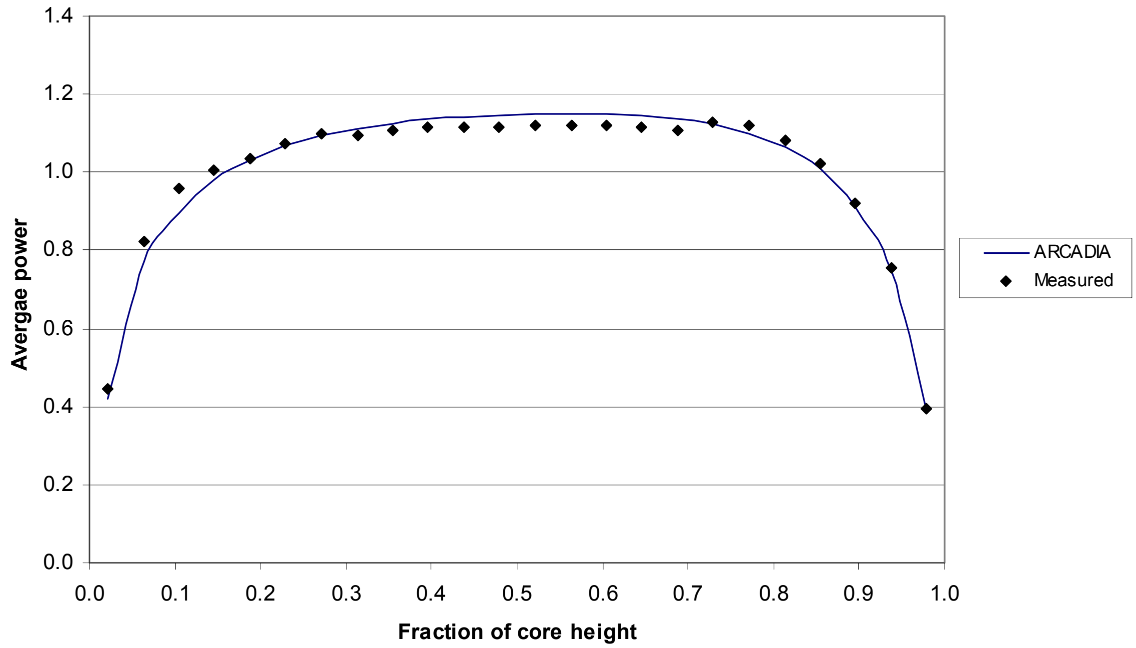
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.4

Figure T1 10.4.8-40: Plant T1 EOC 12 Core Average Axial Power Distribution



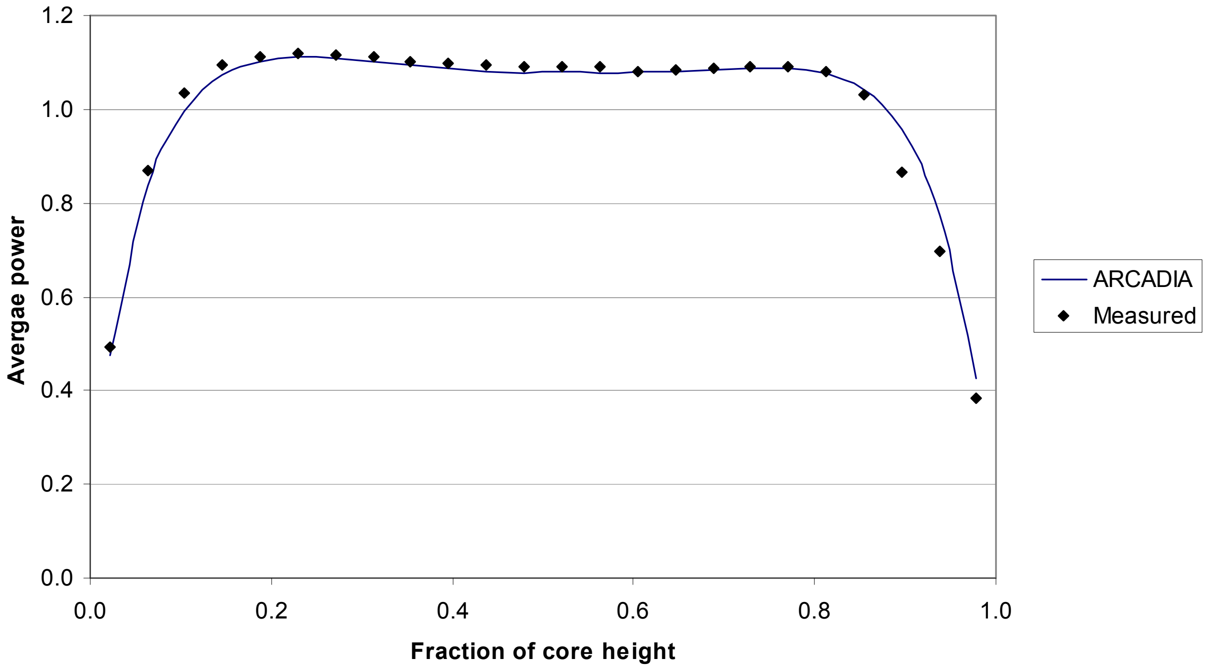
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.7

Figure T1 10.4.8-41: Plant T1 BOC 13 Core Average Axial Power Distribution



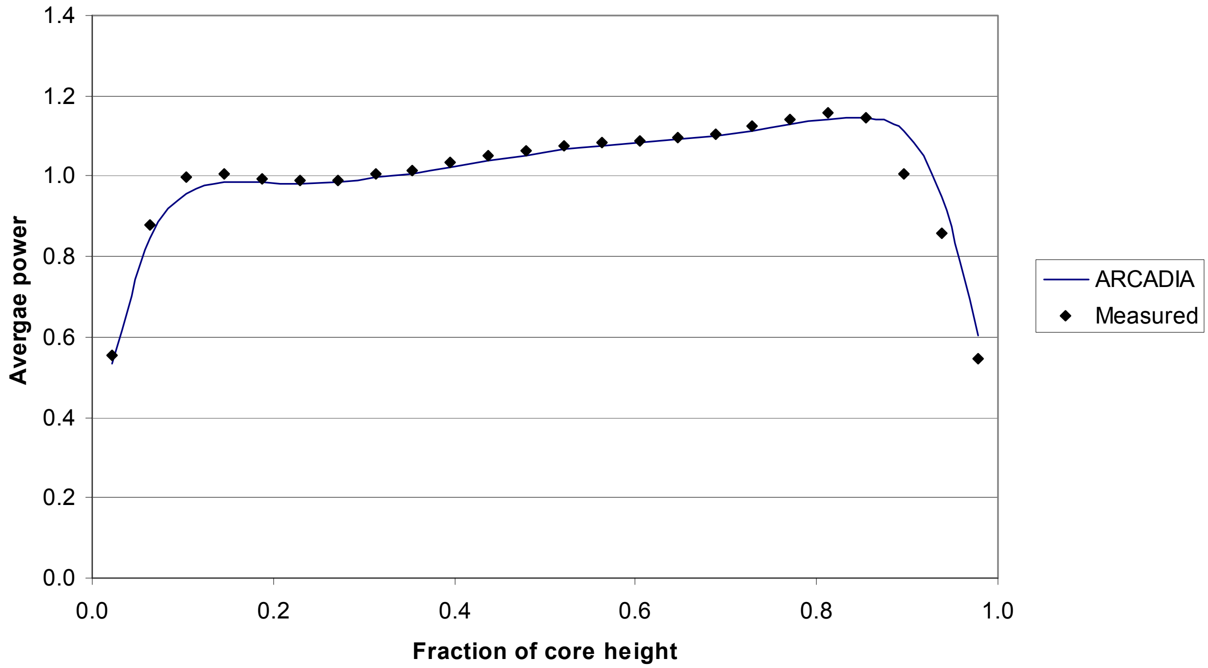
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.6

Figure T1 10.4.8-42: Plant T1 MOC 13 Core Average Axial Power Distribution



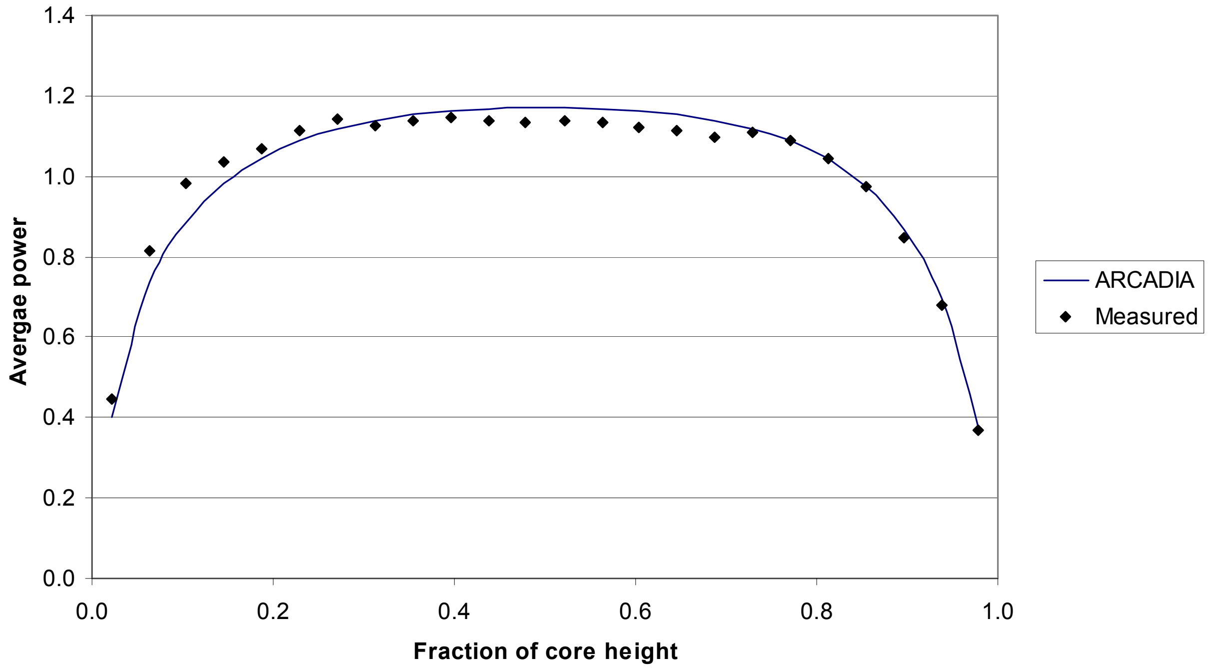
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.9

Figure T1 10.4.8-43: Plant T1 EOC 13 Core Average Axial Power Distribution



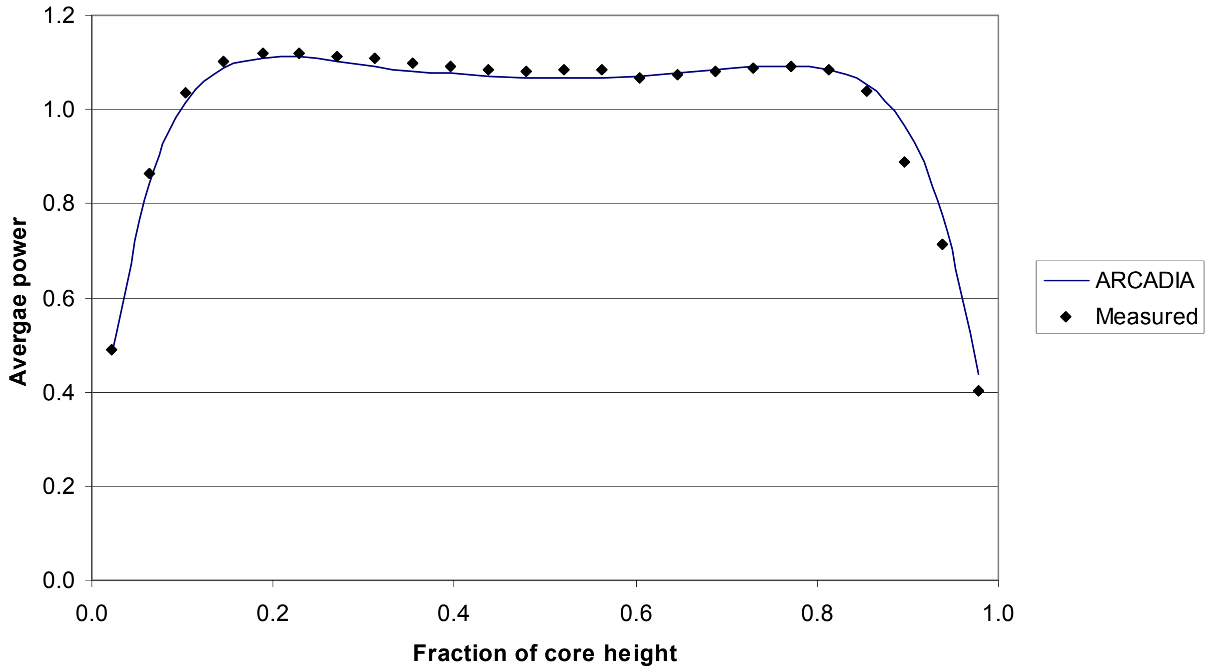
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.4

Figure T1 10.4.8-44: Plant T1 BOC 14 Core Average Axial Power Distribution



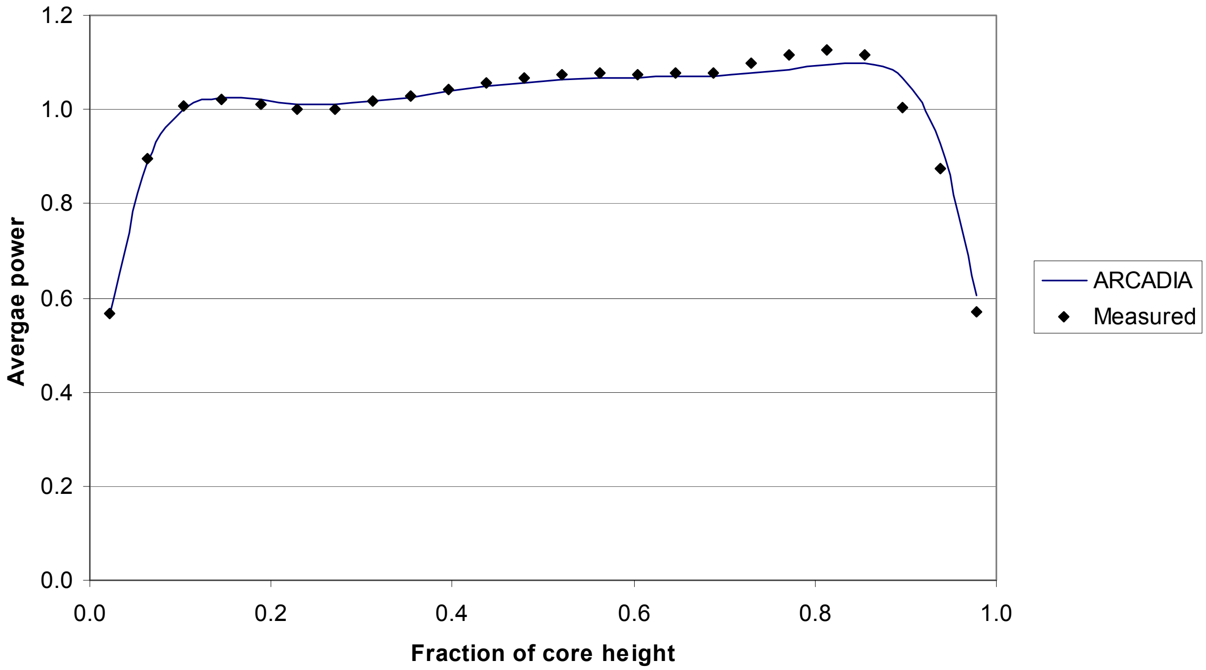
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 3.7

Figure T1 10.4.8-45: Plant T1 MOC 14 Core Average Axial Power Distribution



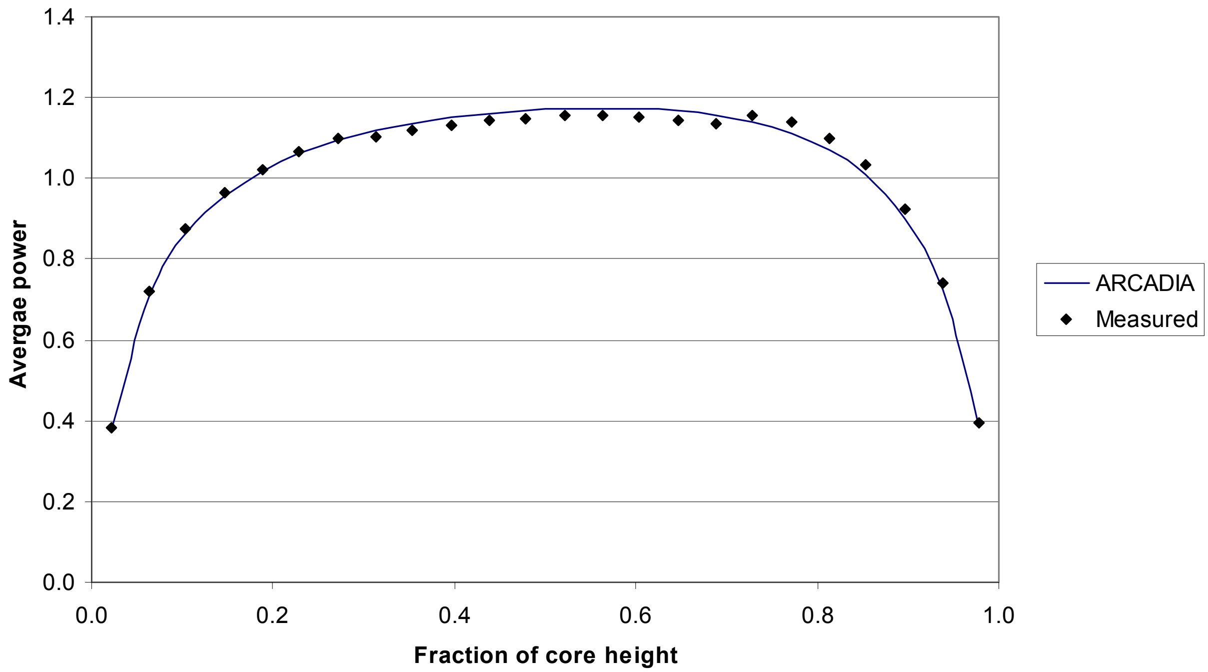
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.5

Figure T1 10.4.8-46: Plant T1 EOC 14 Core Average Axial Power Distribution



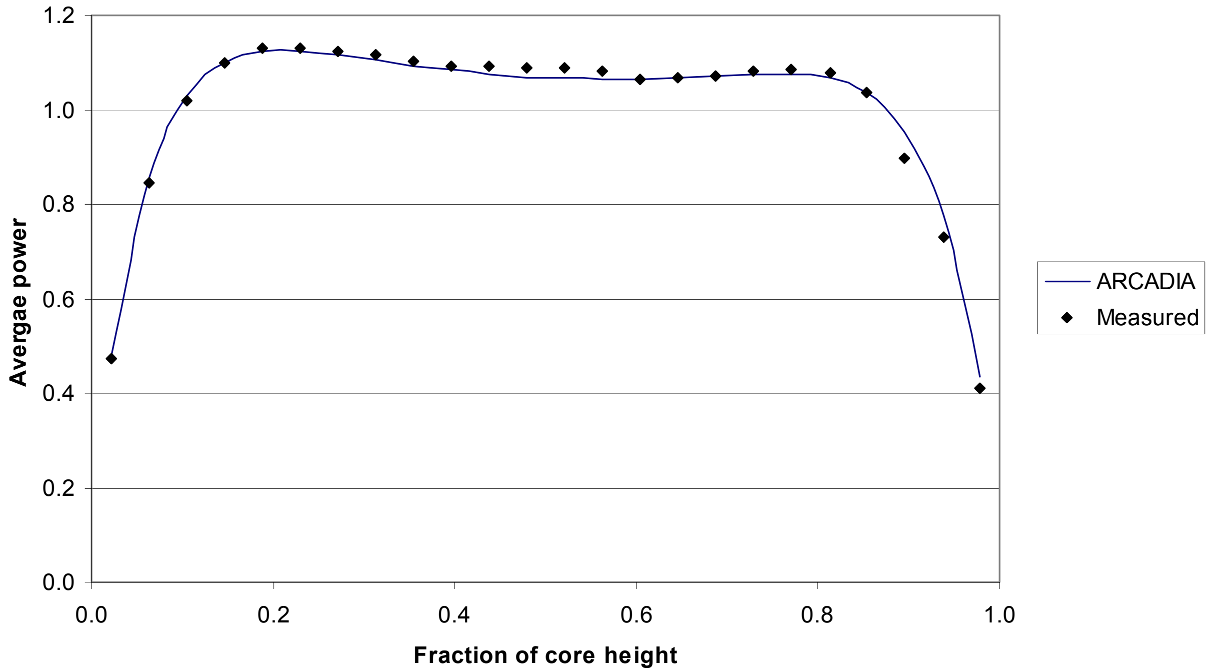
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.2

Figure T1 10.4.8-47: Plant T1 BOC 15 Core Average Axial Power Distribution



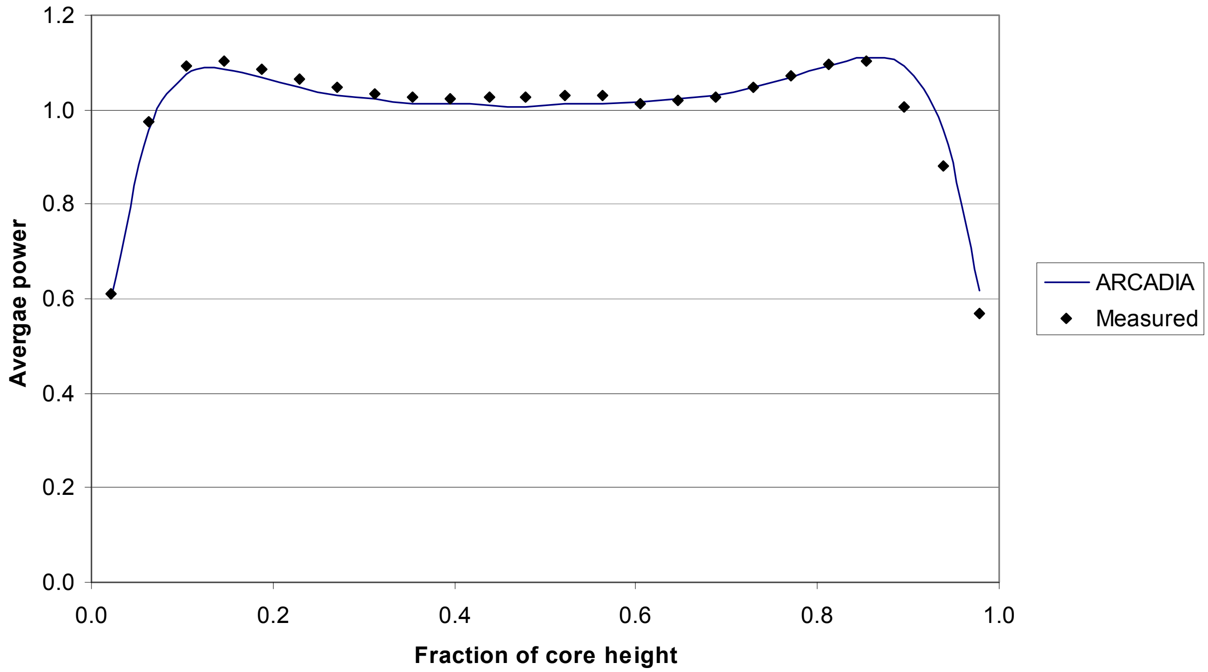
Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 1.7

Figure T1 10.4.8-48: Plant T1 MOC 15 Core Average Axial Power Distribution



Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 1.8

Figure T1 10.4.8-49: Plant T1 EOC 15 Core Average Axial Power Distribution



Calculated minus Measured Average Core Axial Powers, RMS difference * 100 = 2.8

Appendix V1

Table V1 10.3.9-1: Plant V1 Hot Zero Power All Rods Out Critical Boron Concentrations for Cycles 18-22

Cycle	Measured (ppm)	Calculated (ppm)	Difference C - M (ppm)
18	1472	1480	8
19	1663	1642	-22
20	1695	1688	-7
21	1720	1710	-10
22	1729	1707	-22

Table V1 10.3.9-2: Plant V1 Cycle 18 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
D	739	778	39	5.3
C	907	999	92	10.1
B	1578	1676	98	6.2
A	1113	1121	8	0.7
Total	4337	4574	237	5.5

Table V1 10.3.9-3: Plant V1 Cycle 19 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
D	806	792	-14	-1.7
C	1097	1099	2	0.2
B	1494	1608	114	7.6
A	1324	1433	109	8.2
Total	4721	4932	211	4.5

Table V1 10.3.9-4: Plant V1 Cycle 20 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
D	856	863	7	0.8
C	867	889	22	2.5
B	1475	1588	113	7.7
A	1435	1488	53	3.7
Total	4633	4828	195	4.2

Table V1 10.3.9-5: Plant V1 Cycle 21 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
D	897	900	3	0.3
C	868	889	21	2.4
B	1613	1705	92	5.7
A	1246	1294	48	3.9
Total	4624	4788	164	3.5

Table V1 10.3.9-6: Plant V1 Cycle 22 Hot Zero Power Individual Rod Bank Worth

Bank	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
D	872	880	8	0.9
C	860	887	27	3.1
B	1627	1686	59	3.6
A	1270	1344	74	5.8
Total	4629	4797	168	3.6

Table V1 10.3.9-7: Plant V1 Summary of Total Bank Worth

Cycle	Measured (pcm)	Calculated (pcm)	C-M (pcm)	100*(C-M)/M (%)
18	4337	4574	237	5.5
19	4721	4932	211	4.5
20	4633	4828	195	4.2
21	4624	4788	164	3.5
22	4629	4797	168	3.6

Table V1 10.3.9-8: Hot Zero Power All Rods Out Isothermal Temperature Coefficient for Cycles 18-22

Cycle	Measured (pcm/°F)	Calculated (pcm/°F)	Difference C-M (pcm/°F)
18	-3.1	-1.7	-1.4
19	-1.3	-1.9	0.5
20	-2.3	-3.2	0.9
21	-2.6	-3.4	0.8
22	-2.5	-3.0	0.4

Figure V1 10.2.1-7: Plant V1 Fuel Assembly Guide Tube Configuration

3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	1	3	3	3	3	3	3	3
3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	1	3	3	3	2	3	3	3	1	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	1	3	3	3	3	3	3	3	3	3	1	3	3
3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
3	3	3	3	3	3	3	1	3	3	3	3	3	3	3
3	3	1	3	3	1	3	3	3	1	3	3	1	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1	Guide tube
2	Guide tube with instrument
3	UO_2 Rod

Figure V1 10.4.9-1: Plant V1 Cycle 18 Critical Boron Concentration vs. Burnup

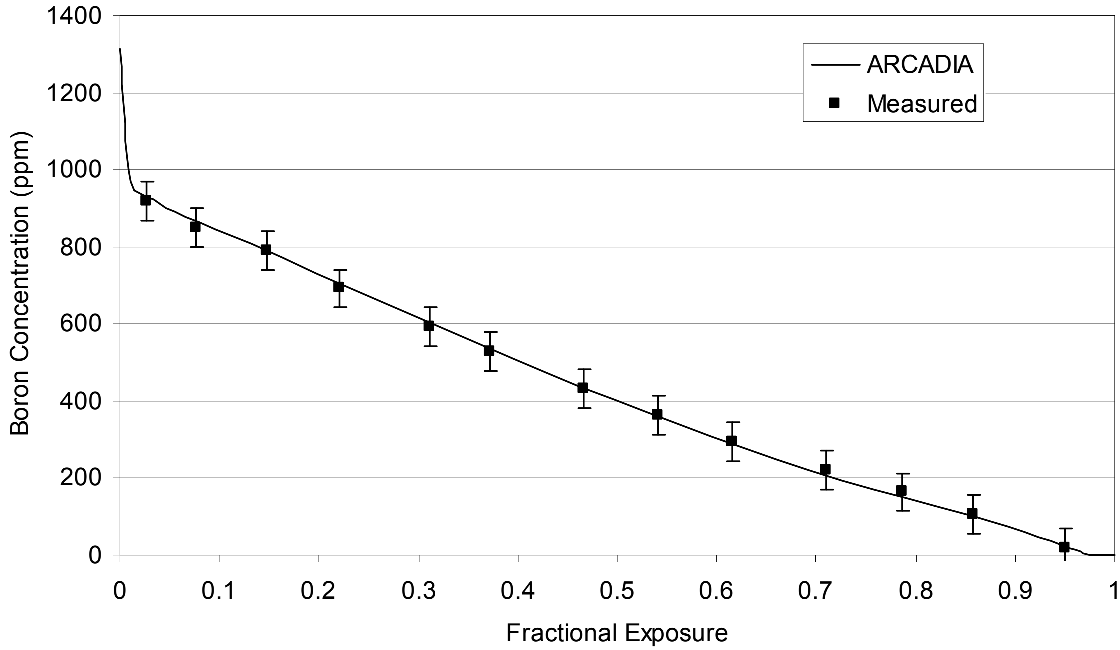


Figure V1 10.4.9-2: Plant V1 Cycle 19 Critical Boron Concentration vs. Burnup

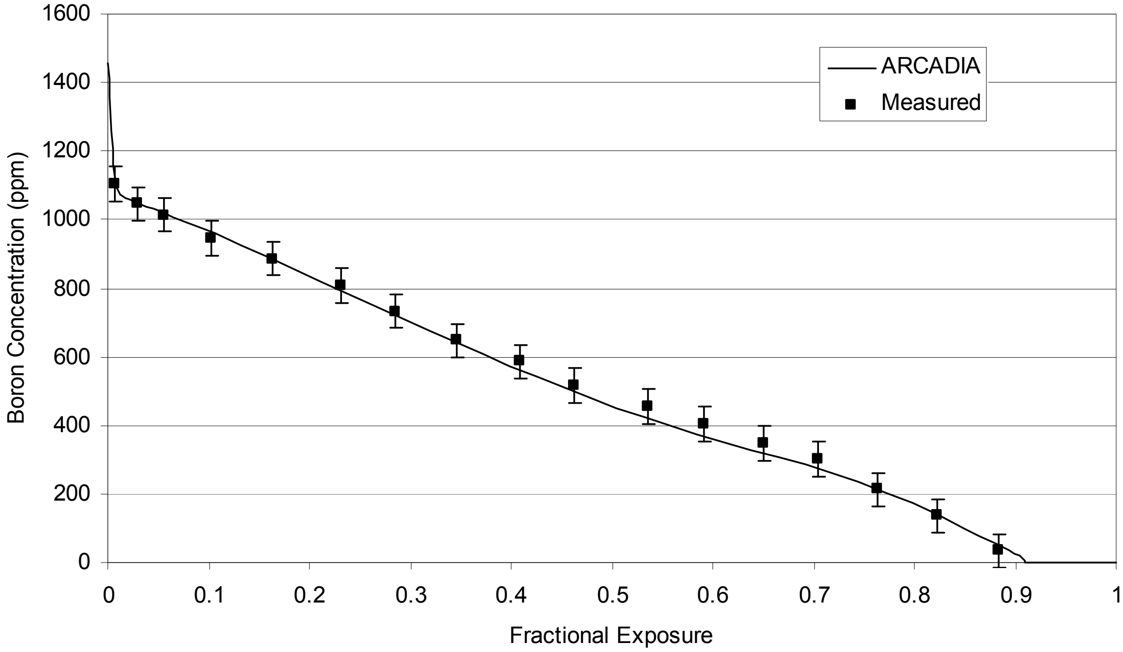


Figure V1 10.4.9-3: Plant V1 Cycle 20 Critical Boron Concentration vs. Burnup

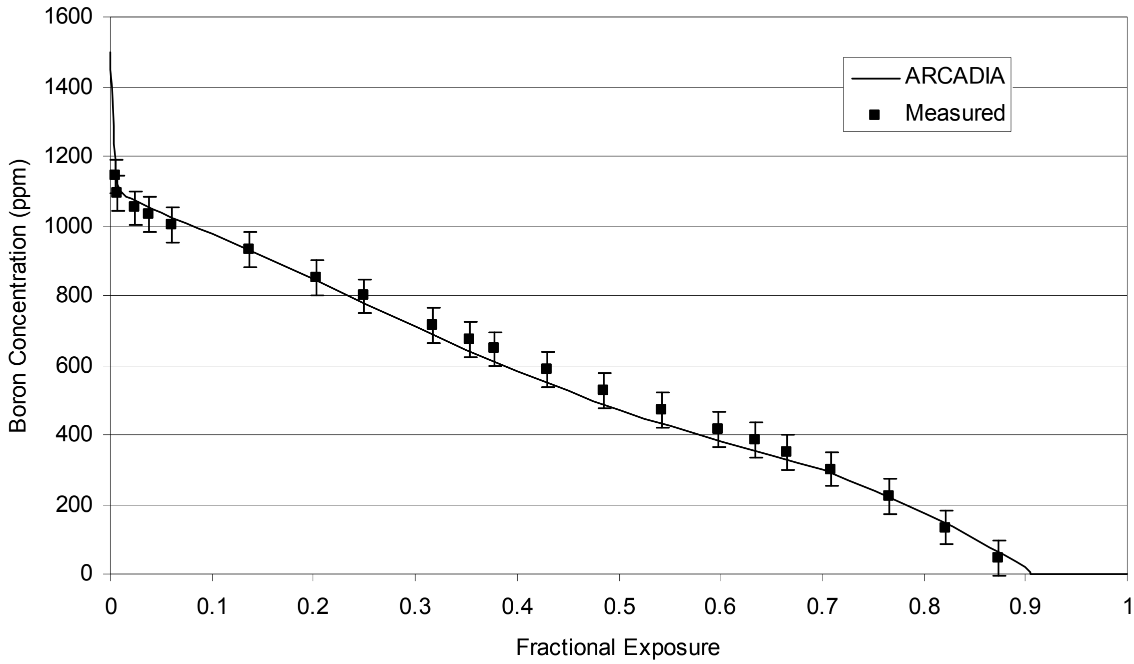


Figure V1 10.4.9-4: Plant V1 Cycle 21 Critical Boron Concentration vs. Burnup

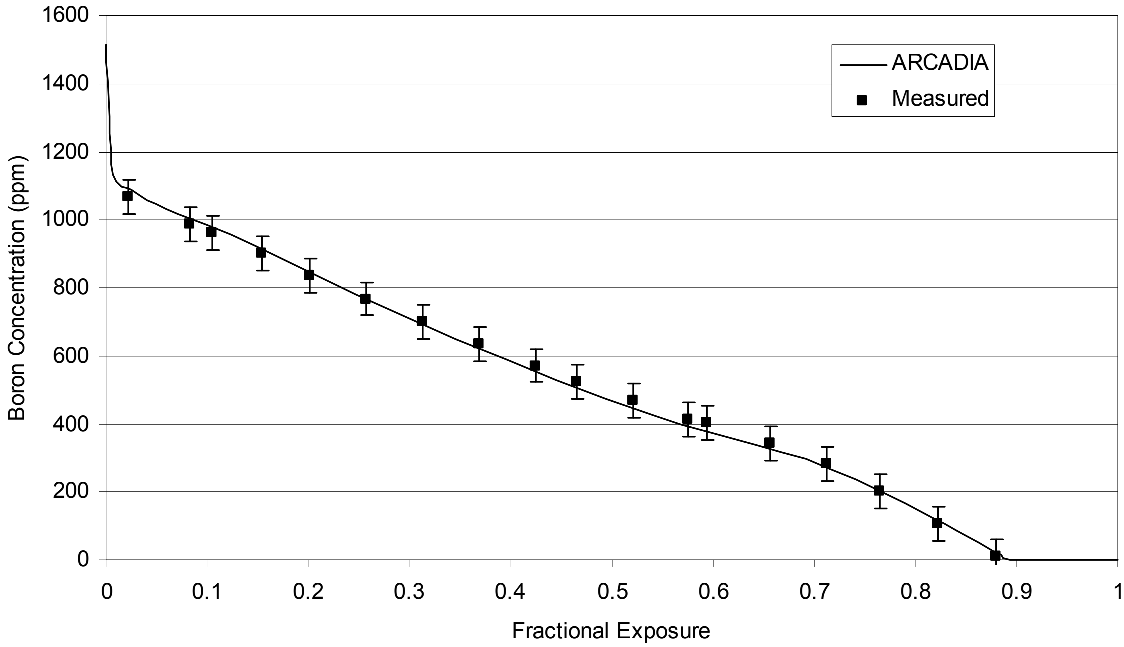


Figure V1 10.4.9-5: Plant V1 Cycle 22 Critical Boron Concentration vs. Burnup

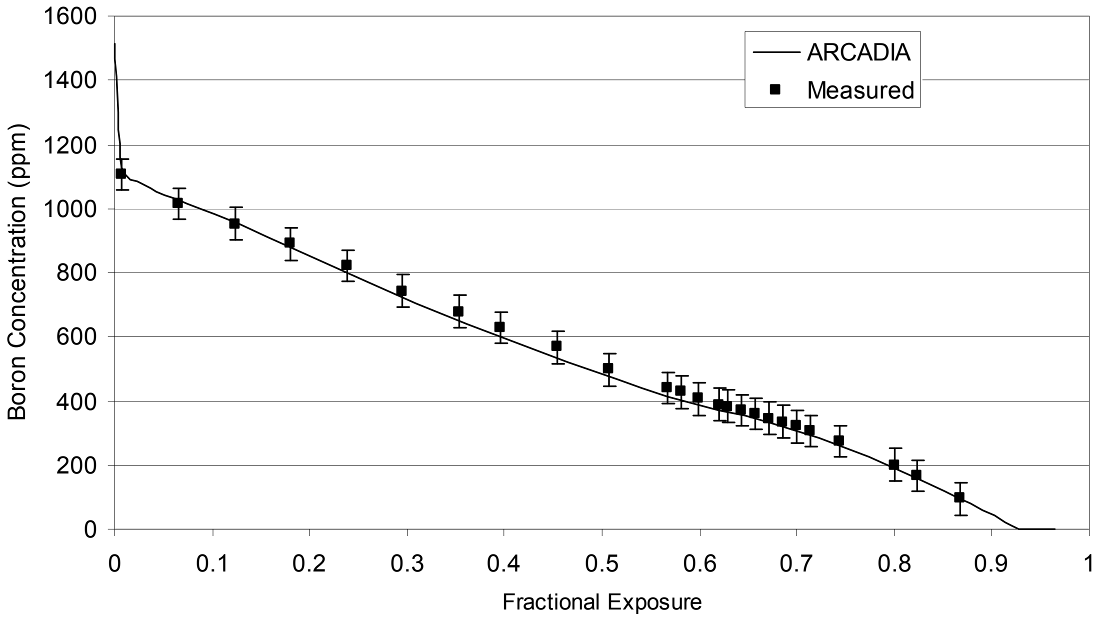


Figure V1 10.4.9-6: Plant V1 BOC 18 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.284 0.284 0	0.335 0.338 -0.3	0.282 0.282 0						
B					0.818 0.811 0.7	0.95 0.946 0.4	0.91 0.909 0.1	0.833 0.832 0.1	0.915 0.913 0.2	0.946 0.935 1.1	0.783 0.781 0.2				
C				0.471 0.467 0.4	1.189 1.174 1.5	1.167 1.161 0.6	1.128 1.13 -0.3	0.923 0.92 0.3	1.147 1.15 -0.3	1.166 1.169 -0.2	1.177 1.183 -0.6	0.459 0.469 -1			
D			0.46 0.453 0.7	1.089 1.072 1.7	1.145 1.116 2.9	1.208 1.203 0.5	1.184 1.196 -1.2	1.271 1.302 -3.1	1.209 1.224 -1.5	1.207 1.219 -1.1	1.134 1.142 -0.8	1.086 1.086 0	0.471 0.469 0.1		
E		0.784 0.775 0.9	1.179 1.16 1.9	1.137 1.128 0.9	1.189 1.194 -0.5	1.002 1.006 -0.4	1.284 1.306 -2.2	1.075 1.091 -1.5	1.293 1.308 -1.5	0.997 1.009 -1.3	1.187 1.204 -1.6	1.144 1.128 1.6	1.19 1.182 0.8	0.819 0.815 0.4	
F		0.95 0.944 0.7	1.169 1.161 0.8	1.209 1.204 0.5	0.997 0.996 0.1	1.142 1.142 0.1	1.044 1.044 -0.1	1.196 1.2 -0.4	1.045 1.052 -0.7	1.14 1.159 -1.9	1 1.007 -0.8	1.209 1.206 0.2	1.169 1.168 0	0.953 0.956 -0.3	
G	0.288 0.287 0.1	0.924 0.921 0.3	1.151 1.152 -0.1	1.212 1.21 0.2	1.294 1.292 0.3	1.045 1.038 0.6	1.204 1.182 2.2	1.178 1.17 0.8	1.198 1.192 0.6	1.038 1.042 -0.3	1.281 1.285 -0.4	1.184 1.186 -0.1	1.131 1.135 -0.4	0.916 0.931 -1.5	0.286 0.29 -0.4
H	0.347 0.345 0.1	0.844 0.841 0.3	0.928 0.925 0.2	1.274 1.274 0	1.075 1.074 0.1	1.195 1.192 0.3	1.167 1.158 0.9	0.994 0.986 0.7	1.14 1.132 0.7	1.184 1.183 0.1	1.071 1.072 -0.1	1.271 1.273 -0.2	0.926 0.927 -0.1	0.844 0.848 -0.4	0.346 0.349 -0.3
K	0.286 0.284 0.2	0.917 0.911 0.5	1.132 1.127 0.5	1.187 1.192 -0.5	1.285 1.311 -2.6	1.046 1.05 -0.5	1.21 1.206 0.4	1.186 1.178 0.8	1.2 1.185 1.5	1.039 1.032 0.7	1.29 1.291 -0.1	1.21 1.213 -0.3	1.15 1.152 -0.2	0.923 0.924 -0.1	0.288 0.292 -0.4
L		0.954 0.945 0.9	1.17 1.154 1.5	1.21 1.21 0	1.002 1.011 -0.8	1.144 1.148 -0.4	1.049 1.047 0.2	1.199 1.192 0.7	1.043 1.036 0.6	1.139 1.137 0.2	0.994 0.999 -0.5	1.207 1.216 -0.9	1.168 1.17 -0.2	0.95 0.942 0.8	
M		0.82 0.814 0.6	1.19 1.184 0.6	1.146 1.147 -0.2	1.19 1.201 -1.1	0.999 1.002 -0.3	1.295 1.294 0.1	1.075 1.066 0.9	1.283 1.279 0.5	1.001 1.003 -0.3	1.188 1.202 -1.5	1.135 1.141 -0.6	1.178 1.182 -0.4	0.784 0.782 0.1	
N			0.471 0.472 -0.1	1.088 1.091 -0.2	1.136 1.14 -0.4	1.209 1.212 -0.3	1.21 1.213 -0.2	1.271 1.27 0.2	1.184 1.181 0.3	1.207 1.203 0.5	1.144 1.143 0.1	1.087 1.083 0.4	0.459 0.466 -0.7		
O				0.46 0.46 0	1.178 1.178 0.1	1.167 1.169 -0.2	1.147 1.151 -0.3	0.923 0.927 -0.3	1.128 1.127 0.1	1.166 1.149 1.7	1.188 1.18 0.8	0.471 0.468 0.2			
P					0.783 0.776 0.8	0.947 0.947 0	0.916 0.922 -0.6	0.833 0.841 -0.7	0.91 0.923 -1.3	0.95 0.947 0.2	0.818 0.814 0.4				
R							0.282 0.292 -1	0.335 0.34 -0.5	0.284 0.288 -0.4						

Calculated power
Measured power
Difference (C-M)*100

Calculated minus Measured Average Assembly Powers, RMS difference = 0.8

Figure V1 10.4.9-7: Plant V1 MOC 18 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.338 0.338 0	0.407 0.407 0.1	0.336 0.335 0.1						
B					0.821 0.816 0.6	0.991 0.987 0.3	0.972 0.972 0.1	0.96 0.957 0.3	0.977 0.973 0.4	0.989 0.979 1	0.791 0.788 0.3				
C				0.492 0.488 0.4	1.193 1.181 1.2	1.158 1.153 0.5	1.219 1.223 -0.4	0.96 0.955 0.4	1.235 1.235 0	1.159 1.159 0	1.186 1.187 -0.1	0.481 0.488 -0.7			
D			0.482 0.475 0.7	1.095 1.08 1.5	1.107 1.084 2.3	1.259 1.254 0.5	1.143 1.148 -0.5	1.197 1.209 -1.2	1.16 1.168 -0.8	1.259 1.268 -0.9	1.101 1.101 0	1.094 1.087 0.7	0.492 0.487 0.5		
E		0.791 0.783 0.8	1.186 1.168 1.8	1.102 1.092 0.9	1.14 1.136 0.4	0.979 0.981 -0.2	1.197 1.211 -1.4	1.006 1.019 -1.3	1.203 1.217 -1.4	0.975 0.985 -1	1.14 1.14 0	1.107 1.084 2.3	1.194 1.179 1.5	0.822 0.813 0.9	
F		0.991 0.986 0.5	1.16 1.154 0.6	1.26 1.258 0.2	0.974 0.98 -0.6	1.163 1.169 -0.6	0.992 1 -0.9	1.19 1.212 -2.3	0.993 1.009 -1.6	1.163 1.19 -2.8	0.978 0.983 -0.5	1.261 1.251 1	1.16 1.152 0.8	0.993 0.988 0.5	
G	0.342 0.342 0.1	0.984 0.982 0.2	1.238 1.241 -0.3	1.161 1.161 0	1.203 1.205 -0.2	0.992 0.993 -0.1	1.107 1.106 0.1	1.075 1.085 -0.9	1.104 1.114 -1	0.989 1.003 -1.4	1.196 1.202 -0.6	1.144 1.135 0.8	1.222 1.218 0.4	0.977 0.982 -0.4	0.34 0.342 -0.2
H	0.419 0.417 0.2	0.97 0.967 0.3	0.963 0.96 0.3	1.198 1.196 0.2	1.005 1.003 0.2	1.188 1.19 -0.2	1.065 1.067 -0.2	0.907 0.912 -0.5	1.045 1.055 -1	1.181 1.205 -2.4	1.003 1.012 -0.9	1.198 1.199 -0.1	0.963 0.961 0.2	0.97 0.98 -0.9	0.419 0.422 -0.4
K	0.34 0.338 0.2	0.977 0.971 0.6	1.222 1.215 0.7	1.144 1.142 0.2	1.197 1.207 -1	0.992 0.995 -0.3	1.111 1.113 -0.2	1.081 1.084 -0.4	1.105 1.109 -0.4	0.989 1.005 -1.7	1.202 1.214 -1.2	1.161 1.168 -0.7	1.239 1.243 -0.4	0.984 0.988 -0.4	0.342 0.344 -0.2
L		0.992 0.983 0.9	1.16 1.145 1.5	1.261 1.253 0.7	0.979 0.977 0.2	1.164 1.164 0	0.994 0.995 0	1.191 1.195 -0.4	0.991 0.996 -0.5	1.162 1.175 -1.3	0.973 0.982 -1	1.259 1.271 -1.2	1.16 1.165 -0.5	0.992 0.99 0.2	
M		0.822 0.815 0.7	1.193 1.183 1	1.107 1.099 0.9	1.141 1.131 1	0.975 0.971 0.5	1.204 1.201 0.3	1.006 1.006 -0.1	1.197 1.202 -0.5	0.978 0.991 -1.2	1.14 1.151 -1	1.101 1.107 -0.6	1.186 1.194 -0.8	0.791 0.794 -0.3	
N			0.492 0.491 0.1	1.094 1.087 0.8	1.101 1.092 1	1.26 1.251 0.8	1.161 1.154 0.6	1.197 1.194 0.2	1.143 1.143 0	1.26 1.262 -0.2	1.107 1.108 -0.1	1.094 1.091 0.3	0.481 0.492 -1.1		
O				0.482 0.477 0.5	1.186 1.172 1.4	1.159 1.149 1	1.235 1.229 0.6	0.96 0.957 0.3	1.219 1.216 0.2	1.158 1.149 0.9	1.193 1.189 0.4	0.492 0.491 0.1			
P					0.791 0.772 1.8	0.989 0.978 1.1	0.977 0.973 0.4	0.96 0.959 0.1	0.972 0.975 -0.2	0.991 0.988 0.3	0.821 0.819 0.2				
R							0.336 0.341 -0.5	0.407 0.409 -0.1	0.338 0.339 -0.1						

Calculated minus Measured Average Assembly Powers, RMS difference = 0.8

Figure V1 10.4.9-8: Plant V1 EOC 18 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.377 0.375 0.2	0.461 0.462 -0.1	0.375 0.373 0.2						
B					0.809 0.803 0.6	1.021 1.013 0.8	1.018 1.01 0.8	1.083 1.077 0.6	1.021 1.012 1	1.02 1.001 1.9	0.78 0.771 1				
C				0.499 0.501 -0.1	1.199 1.19 0.9	1.155 1.147 0.8	1.339 1.325 1.4	0.994 0.992 0.2	1.355 1.345 1	1.156 1.143 1.4	1.193 1.183 1	0.489 0.496 -0.7			
D			0.489 0.483 0.6	1.091 1.082 0.9	1.069 1.056 1.3	1.341 1.336 0.5	1.109 1.11 -0.2	1.124 1.132 -0.8	1.122 1.119 0.3	1.341 1.32 2.1	1.065 1.055 1	1.091 1.079 1.1	0.499 0.494 0.5		
E		0.781 0.768 1.2	1.194 1.17 2.4	1.066 1.058 0.8	1.084 1.084 -0.1	0.955 0.96 -0.5	1.113 1.13 -1.7	0.938 0.949 -1.1	1.117 1.124 -0.7	0.951 0.952 -0.2	1.084 1.079 0.5	1.07 1.047 2.3	1.2 1.185 1.5	0.809 0.803 0.6	
F		1.023 1.01 1.3	1.157 1.143 1.3	1.341 1.338 0.3	0.95 0.966 -1.6	1.199 1.213 -1.4	0.941 0.954 -1.3	1.2 1.221 -2.2	0.942 0.957 -1.5	1.199 1.223 -2.4	0.954 0.957 -0.3	1.342 1.33 1.2	1.157 1.148 0.9	1.023 1.018 0.5	
G	0.381 0.378 0.3	1.028 1.017 1.1	1.358 1.338 2	1.123 1.121 0.2	1.117 1.125 -0.9	0.941 0.95 -0.9	1.01 1.019 -0.9	0.975 0.988 -1.3	1.008 1.022 -1.4	0.939 0.954 -1.5	1.112 1.117 -0.5	1.11 1.101 0.8	1.342 1.335 0.7	1.022 1.023 -0.1	0.378 0.38 -0.2
H	0.472 0.469 0.2	1.095 1.09 0.5	0.998 1.001 -0.3	1.125 1.128 -0.3	0.936 0.945 -0.8	1.198 1.209 -1.1	0.965 0.974 -0.9	0.811 0.821 -1	0.949 0.963 -1.4	1.191 1.217 -2.6	0.935 0.944 -0.9	1.125 1.124 0	0.998 0.995 0.2	1.095 1.112 -1.7	0.472 0.477 -0.6
K	0.378 0.377 0.2	1.022 1.017 0.5	1.342 1.338 0.5	1.11 1.111 -0.2	1.113 1.125 -1.2	0.941 0.949 -0.8	1.012 1.021 -0.8	0.978 0.988 -1	1.008 1.019 -1.1	0.939 0.964 -2.5	1.116 1.127 -1.1	1.123 1.123 0	1.358 1.357 0.1	1.028 1.033 -0.5	0.381 0.382 -0.2
L		1.023 1.015 0.8	1.157 1.143 1.4	1.342 1.337 0.5	0.954 0.956 -0.2	1.2 1.205 -0.4	0.943 0.949 -0.6	1.201 1.212 -1.1	0.941 0.952 -1.1	1.198 1.217 -1.9	0.949 0.954 -0.6	1.341 1.328 1.3	1.157 1.156 0.1	1.023 1.024 -0.1	
M		0.809 0.804 0.5	1.199 1.193 0.6	1.069 1.066 0.4	1.084 1.08 0.4	0.951 0.95 0.1	1.117 1.119 -0.2	0.937 0.945 -0.8	1.112 1.124 -1.2	0.954 0.974 -2	1.084 1.091 -0.8	1.065 1.065 0.1	1.194 1.198 -0.4	0.781 0.783 -0.2	
N			0.499 0.505 -0.6	1.091 1.089 0.2	1.065 1.061 0.5	1.341 1.335 0.6	1.122 1.116 0.6	1.124 1.124 0	1.109 1.112 -0.3	1.341 1.346 -0.5	1.069 1.071 -0.1	1.091 1.087 0.3	0.489 0.504 -1.5		
O				0.49 0.488 0.2	1.193 1.184 0.9	1.156 1.15 0.7	1.355 1.348 0.7	0.995 0.99 0.4	1.339 1.335 0.4	1.155 1.148 0.7	1.199 1.195 0.4	0.499 0.498 0.1			
P					0.78 0.768 1.2	1.02 1.012 0.8	1.021 1.018 0.4	1.083 1.08 0.4	1.018 1.016 0.2	1.021 1.017 0.4	0.809 0.806 0.3				
R							0.374 0.379 -0.5	0.461 0.461 0	0.377 0.377 0						

Calculated minus Measured Average Assembly Powers, RMS difference = 1.0

Figure V1 10.4.9-9: Plant V1 BOC 19 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.243 0.238 0.5	0.272 0.264 0.9	0.254 0.25 0.4						
B					0.794 0.779 1.5	0.986 0.97 1.6	0.862 0.849 1.3	0.65 0.648 0.2	0.902 0.895 0.7	0.997 0.978 2	0.804 0.793 1.1				
C				0.454 0.441 1.2	1.15 1.126 2.4	1.109 1.091 1.8	1.119 1.099 2	1.215 1.236 -2.1	1.12 1.123 -0.2	1.114 1.107 0.7	1.157 1.147 1	0.484 0.474 1			
D			0.484 0.472 1.3	1.081 1.057 2.5	1.171 1.144 2.7	1.19 1.176 1.4	1.108 1.102 0.5	0.981 0.973 0.8	1.099 1.101 -0.1	1.179 1.178 0.2	1.179 1.174 0.4	1.079 1.071 0.9	0.453 0.449 0.5		
E		0.804 0.783 2	1.158 1.123 3.5	1.18 1.158 2.2	1.197 1.185 1.1	1.038 1.038 0.1	1.204 1.224 -2	1.258 1.275 -1.7	1.207 1.22 -1.4	1.036 1.042 -0.6	1.192 1.197 -0.5	1.166 1.158 0.8	1.148 1.134 1.4	0.793 0.774 1.9	
F		0.997 0.977 2	1.114 1.091 2.3	1.179 1.162 1.7	1.034 1.024 1	1.193 1.198 -0.4	1.198 1.217 -1.9	1.326 1.365 -3.9	1.201 1.227 -2.6	1.198 1.214 -1.6	1.039 1.044 -0.6	1.185 1.18 0.4	1.108 1.097 1.1	0.985 0.969 1.6	
G	0.253 0.25 0.3	0.901 0.887 1.3	1.119 1.1 1.9	1.097 1.088 0.9	1.205 1.202 0.3	1.2 1.207 -0.7	1.281 1.298 -1.7	1.234 1.264 -3	1.279 1.32 -4.1	1.2 1.229 -2.8	1.208 1.223 -1.5	1.106 1.104 0.2	1.117 1.107 1	0.861 0.845 1.6	0.243 0.238 0.5
H	0.272 0.27 0.2	0.649 0.647 0.2	1.213 1.23 -1.7	0.979 0.98 -0.1	1.257 1.258 -0.1	1.326 1.336 -1	1.237 1.254 -1.7	0.992 1.014 -2.1	1.229 1.265 -3.6	1.324 1.371 -4.7	1.258 1.281 -2.3	0.98 0.984 -0.4	1.214 1.204 1	0.65 0.627 2.3	0.272 0.266 0.6
K	0.243 0.24 0.3	0.86 0.848 1.2	1.116 1.106 1.1	1.104 1.102 0.2	1.203 1.217 -1.5	1.198 1.21 -1.2	1.281 1.298 -1.7	1.232 1.255 -2.4	1.275 1.307 -3.3	1.198 1.224 -2.6	1.206 1.225 -2	1.098 1.107 -0.9	1.119 1.116 0.3	0.901 0.89 1.1	0.254 0.257 -0.4
L		0.984 0.957 2.7	1.106 1.064 4.2	1.186 1.171 1.5	1.034 1.036 -0.2	1.196 1.204 -0.8	1.202 1.215 -1.3	1.324 1.346 -2.3	1.195 1.218 -2.3	1.192 1.214 -2.2	1.034 1.051 -1.7	1.179 1.193 -1.4	1.114 1.114 0	0.997 0.983 1.4	
M		0.792 0.773 1.9	1.146 1.121 2.5	1.166 1.154 1.1	1.187 1.19 -0.3	1.03 1.033 -0.3	1.207 1.215 -0.8	1.256 1.28 -2.3	1.202 1.221 -1.9	1.037 1.053 -1.6	1.196 1.22 -2.4	1.18 1.191 -1.2	1.158 1.159 -0.2	0.804 0.799 0.4	
N			0.452 0.448 0.4	1.076 1.069 0.7	1.171 1.168 0.4	1.171 1.167 0.3	1.096 1.087 1	0.979 0.991 -1.2	1.106 1.115 -0.9	1.189 1.19 -0.2	1.169 1.175 -0.5	1.081 1.088 -0.7	0.484 0.482 0.2		
O				0.482 0.479 0.3	1.152 1.145 0.7	1.109 1.108 0.2	1.117 1.125 -0.8	1.212 1.25 -3.7	1.117 1.12 -0.3	1.108 1.083 2.5	1.148 1.139 1	0.453 0.453 0.1			
P					0.801 0.788 1.3	0.994 0.99 0.4	0.899 0.903 -0.4	0.649 0.655 -0.6	0.861 0.851 1	0.985 0.969 1.6	0.793 0.784 0.9				
R							0.253 0.256 -0.3	0.272 0.273 -0.2	0.243 0.241 0.2						

Calculated power
Measured power
Difference (C-M)*100

Calculated minus Measured Average Assembly Powers, RMS difference = 1.6

Figure V1 10.4.9-10: Plant V1 MOC 19 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.271 0.271 0	0.311 0.312 -0.1	0.282 0.283 -0.1						
B					0.755 0.752 0.3	0.955 0.953 0.2	0.875 0.875 0	0.689 0.694 -0.5	0.914 0.917 -0.3	0.964 0.959 0.4	0.763 0.762 0.1				
C				0.466 0.466 0	1.128 1.121 0.7	1.084 1.08 0.4	1.204 1.203 0.1	1.263 1.284 -2.1	1.207 1.216 -0.9	1.091 1.095 -0.3	1.136 1.139 -0.3	0.496 0.494 0.1			
D			0.496 0.488 0.8	1.086 1.076 1.1	1.14 1.125 1.5	1.28 1.277 0.3	1.12 1.121 -0.2	0.985 0.981 0.4	1.117 1.122 -0.5	1.276 1.284 -0.8	1.162 1.167 -0.6	1.085 1.087 -0.2	0.467 0.467 0		
E		0.763 0.751 1.1	1.137 1.114 2.3	1.163 1.152 1	1.295 1.297 -0.2	1.061 1.063 -0.2	1.265 1.282 -1.8	1.214 1.22 -0.6	1.274 1.284 -1.1	1.062 1.075 -1.2	1.291 1.305 -1.4	1.137 1.136 0.1	1.127 1.125 0.2	0.755 0.75 0.5	
F		0.963 0.954 0.9	1.091 1.08 1.1	1.276 1.267 0.8	1.061 1.058 0.3	1.251 1.249 0.1	1.107 1.109 -0.2	1.193 1.192 0.1	1.112 1.124 -1.2	1.256 1.286 -3	1.062 1.074 -1.2	1.276 1.282 -0.5	1.085 1.086 -0.1	0.955 0.954 0.1	
G	0.282 0.281 0.1	0.913 0.91 0.4	1.206 1.2 0.6	1.115 1.108 0.7	1.273 1.26 1.2	1.111 1.103 0.8	1.114 1.106 0.8	1.079 1.08 -0.1	1.113 1.126 -1.2	1.11 1.122 -1.2	1.269 1.279 -1	1.119 1.124 -0.5	1.204 1.207 -0.3	0.875 0.877 -0.1	0.272 0.273 -0.1
H	0.311 0.311 0	0.689 0.692 -0.3	1.262 1.285 -2.2	0.984 0.981 0.3	1.214 1.187 2.7	1.192 1.18 1.2	1.079 1.073 0.6	0.871 0.869 0.1	1.075 1.077 -0.3	1.192 1.193 -0.1	1.216 1.221 -0.6	0.985 0.989 -0.4	1.263 1.267 -0.4	0.689 0.689 0	0.311 0.314 -0.3
K	0.272 0.271 0.1	0.875 0.872 0.3	1.203 1.202 0.2	1.118 1.116 0.2	1.264 1.269 -0.5	1.108 1.104 0.4	1.115 1.11 0.5	1.078 1.075 0.3	1.111 1.109 0.2	1.11 1.116 -0.5	1.274 1.282 -0.8	1.116 1.123 -0.7	1.207 1.211 -0.5	0.914 0.917 -0.3	0.282 0.293 -1.1
L		0.955 0.943 1.2	1.084 1.061 2.3	1.278 1.269 0.9	1.058 1.056 0.2	1.254 1.25 0.4	1.113 1.108 0.6	1.192 1.187 0.5	1.107 1.107 -0.1	1.251 1.26 -0.9	1.061 1.071 -1	1.276 1.288 -1.2	1.092 1.095 -0.4	0.964 0.958 0.6	
M		0.755 0.747 0.8	1.127 1.115 1.1	1.138 1.132 0.6	1.288 1.289 -0.1	1.058 1.053 0.5	1.276 1.267 0.9	1.214 1.203 1.1	1.264 1.266 -0.2	1.061 1.075 -1.4	1.295 1.315 -2	1.163 1.173 -1	1.137 1.142 -0.6	0.763 0.763 0	
N			0.466 0.469 -0.3	1.084 1.081 0.3	1.158 1.153 0.4	1.27 1.263 0.7	1.115 1.102 1.3	0.985 0.985 0	1.119 1.12 0	1.28 1.281 0	1.139 1.143 -0.4	1.086 1.093 -0.7	0.496 0.499 -0.3		
O				0.495 0.493 0.2	1.134 1.128 0.6	1.089 1.086 0.3	1.206 1.21 -0.4	1.263 1.289 -2.6	1.204 1.204 0	1.084 1.065 1.9	1.127 1.121 0.7	0.466 0.466 0			
P					0.762 0.751 1	0.963 0.96 0.3	0.913 0.918 -0.5	0.689 0.694 -0.5	0.875 0.868 0.7	0.955 0.943 1.1	0.755 0.749 0.6				
R							0.282 0.291 -0.9	0.311 0.314 -0.4	0.272 0.271 0.1						

Calculated power
Measured power
Difference (C-M)*100

Calculated minus Measured Average Assembly Powers, RMS difference = 0.9

Figure V1 10.4.9-11: Plant V1 EOC 19 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.299 0.3 -0.1	0.346 0.353 -0.7	0.309 0.311 -0.2						
B					0.739 0.742 -0.3	0.947 0.949 -0.2	0.893 0.893 0	0.724 0.722 0.2	0.931 0.932 -0.1	0.953 0.962 -0.9	0.745 0.75 -0.5				
C				0.488 0.5 -1.2	1.134 1.14 -0.6	1.076 1.075 0	1.298 1.299 -0.1	1.308 1.294 1.4	1.3 1.298 0.2	1.083 1.083 0.1	1.143 1.147 -0.4	0.516 0.523 -0.7			
D			0.516 0.514 0.1	1.11 1.113 -0.3	1.118 1.114 0.4	1.352 1.353 0	1.119 1.118 0.1	0.971 0.979 -0.8	1.117 1.117 0	1.352 1.348 0.4	1.149 1.145 0.5	1.11 1.113 -0.3	0.488 0.489 0		
E		0.745 0.743 0.2	1.143 1.139 0.4	1.15 1.145 0.5	1.365 1.355 1	1.07 1.066 0.5	1.301 1.296 0.5	1.138 1.142 -0.4	1.306 1.313 -0.7	1.072 1.069 0.3	1.363 1.352 1.2	1.118 1.115 0.2	1.135 1.139 -0.4	0.739 0.746 -0.7	
F		0.954 0.952 0.1	1.084 1.08 0.3	1.352 1.352 0	1.071 1.073 -0.2	1.29 1.296 -0.6	1.024 1.028 -0.5	1.053 1.067 -1.4	1.027 1.038 -1.1	1.293 1.299 -0.7	1.071 1.069 0.2	1.351 1.354 -0.3	1.077 1.081 -0.3	0.948 0.954 -0.7	
G	0.309 0.308 0.1	0.931 0.929 0.2	1.3 1.301 0	1.117 1.114 0.3	1.306 1.307 -0.1	1.027 1.029 -0.2	0.966 0.978 -1.2	0.919 0.934 -1.5	0.966 0.994 -2.8	1.025 1.036 -1.1	1.303 1.31 -0.7	1.119 1.12 -0.1	1.298 1.305 -0.7	0.893 0.9 -0.7	0.3 0.303 -0.3
H	0.346 0.345 0.2	0.724 0.722 0.2	1.309 1.308 0.1	0.971 0.966 0.5	1.139 1.13 0.8	1.053 1.052 0.2	0.919 0.923 -0.4	0.742 0.749 -0.7	0.916 0.932 -1.6	1.053 1.064 -1.2	1.139 1.142 -0.4	0.971 0.971 0	1.309 1.316 -0.7	0.724 0.733 -0.9	0.346 0.353 -0.7
K	0.3 0.298 0.1	0.894 0.891 0.3	1.299 1.297 0.3	1.12 1.114 0.6	1.302 1.298 0.3	1.025 1.022 0.3	0.967 0.967 0	0.919 0.925 -0.6	0.965 0.982 -1.7	1.026 1.032 -0.6	1.307 1.309 -0.2	1.117 1.113 0.4	1.3 1.304 -0.4	0.931 0.938 -0.7	0.309 0.324 -1.5
L		0.948 0.946 0.2	1.077 1.071 0.6	1.354 1.348 0.6	1.07 1.061 1	1.294 1.289 0.4	1.029 1.024 0.4	1.054 1.053 0.1	1.024 1.027 -0.2	1.291 1.294 -0.3	1.071 1.063 0.9	1.352 1.338 1.4	1.084 1.079 0.5	0.953 0.954 0	
M		0.74 0.74 0	1.136 1.137 -0.1	1.12 1.112 0.8	1.365 1.344 2.1	1.071 1.06 1.1	1.309 1.303 0.6	1.139 1.133 0.6	1.301 1.3 0.1	1.071 1.068 0.3	1.365 1.346 1.9	1.15 1.137 1.2	1.143 1.141 0.2	0.745 0.744 0	
N			0.488 0.5 -1.2	1.111 1.111 0	1.15 1.14 0.9	1.351 1.343 0.8	1.118 1.106 1.2	0.972 0.963 0.9	1.12 1.112 0.8	1.353 1.345 0.8	1.118 1.106 1.2	1.11 1.102 0.7	0.516 0.522 -0.7		
O				0.516 0.515 0.1	1.144 1.143 0.1	1.084 1.08 0.5	1.301 1.296 0.6	1.31 1.298 1.2	1.299 1.292 0.7	1.076 1.064 1.2	1.134 1.125 0.9	0.488 0.483 0.5			
P					0.746 0.753 -0.7	0.955 0.957 -0.3	0.932 0.935 -0.2	0.725 0.723 0.2	0.894 0.895 -0.1	0.947 0.943 0.5	0.739 0.734 0.5				
R							0.31 0.325 -1.5	0.346 0.35 -0.3	0.3 0.3 -0.1						

Calculated minus Measured Average Assembly Powers, RMS difference = 0.7

Figure V1 10.4.9-12: Plant V1 BOC 20 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.265 0.269 -0.5	0.282 0.298 -1.6	0.261 0.266 -0.5						
B					0.809 0.812 -0.3	1.035 1.039 -0.4	0.957 0.962 -0.5	0.88 0.886 -0.5	0.958 0.964 -0.7	1.032 1.038 -0.6	0.805 0.811 -0.6				
C				0.421 0.433 -1.2	1.137 1.139 -0.2	1.163 1.167 -0.4	1.21 1.215 -0.5	1.164 1.157 0.7	1.212 1.219 -0.7	1.157 1.165 -0.8	1.126 1.136 -0.9	0.436 0.445 -0.9			
D			0.423 0.422 0.1	1.007 1.007 0	1.13 1.119 1.1	1.224 1.229 -0.5	1.095 1.111 -1.6	1.174 1.22 -4.6	1.092 1.111 -1.8	1.211 1.219 -0.8	1.068 1.074 -0.6	1.027 1.028 -0.1	0.43 0.429 0.1		
E		0.801 0.799 0.2	1.115 1.11 0.5	1.057 1.058 -0.1	1.197 1.206 -0.9	1.08 1.089 -0.9	1.198 1.213 -1.5	1.076 1.1 -2.5	1.2 1.221 -2.1	1.079 1.091 -1.1	1.206 1.214 -0.8	1.14 1.128 1.1	1.144 1.138 0.7	0.812 0.81 0.2	
F		1.027 1.026 0.1	1.151 1.15 0.1	1.203 1.205 -0.1	1.072 1.077 -0.4	1.184 1.195 -1.1	1.081 1.098 -1.7	1.227 1.256 -2.9	1.098 1.118 -2.1	1.191 1.207 -1.6	1.084 1.085 -0.1	1.228 1.215 1.3	1.166 1.16 0.6	1.037 1.038 -0.1	
G	0.261 0.261 0	0.955 0.954 0	1.207 1.209 -0.3	1.087 1.087 0	1.19 1.189 0.1	1.083 1.09 -0.7	1.096 1.116 -2	1.218 1.24 -2.3	1.109 1.133 -2.4	1.078 1.09 -1.2	1.197 1.191 0.5	1.094 1.061 3.3	1.21 1.204 0.6	0.957 0.968 -1.1	0.264 0.27 -0.5
H	0.281 0.28 0.1	0.878 0.876 0.2	1.161 1.162 -0.1	1.169 1.165 0.4	1.068 1.054 1.4	1.201 1.202 -0.1	1.191 1.199 -0.8	1.083 1.093 -1	1.215 1.233 -1.7	1.211 1.228 -1.8	1.071 1.071 0	1.171 1.163 0.8	1.162 1.169 -0.7	0.88 0.919 -3.9	0.282 0.294 -1.3
K	0.264 0.262 0.2	0.955 0.947 0.8	1.208 1.198 0.9	1.093 1.09 0.3	1.192 1.203 -1.1	1.07 1.071 -0.1	1.093 1.093 0	1.208 1.21 -0.2	1.102 1.114 -1.2	1.088 1.091 -0.3	1.193 1.19 0.3	1.088 1.083 0.6	1.208 1.209 -0.1	0.956 0.968 -1.2	0.261 0.278 -1.7
L		1.034 1.019 1.5	1.162 1.138 2.4	1.224 1.215 0.9	1.08 1.079 0.2	1.185 1.18 0.5	1.091 1.08 1.1	1.223 1.206 1.6	1.081 1.07 1.1	1.186 1.172 1.4	1.074 1.065 0.8	1.204 1.19 1.4	1.152 1.143 0.9	1.028 1.014 1.4	
M		0.808 0.799 0.9	1.137 1.127 1	1.133 1.128 0.6	1.202 1.201 0.1	1.077 1.067 1	1.196 1.172 2.4	1.073 1.033 4	1.197 1.168 2.9	1.08 1.045 3.5	1.198 1.192 0.6	1.057 1.048 0.9	1.116 1.108 0.8	0.801 0.793 0.8	
N			0.424 0.431 -0.7	1.02 1.018 0.2	1.065 1.059 0.6	1.209 1.195 1.4	1.09 1.064 2.6	1.172 1.148 2.4	1.094 1.075 1.9	1.224 1.201 2.2	1.129 1.116 1.3	1.007 0.996 1.1	0.424 0.425 -0.2		
O				0.434 0.432 0.2	1.124 1.118 0.6	1.155 1.147 0.9	1.21 1.199 1.1	1.163 1.156 0.7	1.209 1.202 0.7	1.162 1.147 1.5	1.134 1.122 1.2	0.419 0.415 0.5			
P					0.804 0.801 0.3	1.031 1.027 0.4	0.956 0.958 -0.2	0.879 0.883 -0.4	0.956 0.97 -1.5	1.034 1.032 0.2	0.807 0.802 0.5				
R							0.261 0.278 -1.7	0.282 0.287 -0.5	0.264 0.268 -0.4						

Calculated minus Measured Average Assembly Powers, RMS difference = 1.3

Figure V1 10.4.9-13: Plant V1 MOC 20 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.288 0.292 -0.3	0.319 0.328 -1	0.285 0.288 -0.3						
B					0.732 0.735 -0.3	0.952 0.957 -0.4	0.933 0.937 -0.4	0.953 0.954 -0.1	0.935 0.939 -0.4	0.952 0.959 -0.7	0.73 0.738 -0.7				
C				0.425 0.436 -1.1	1.077 1.081 -0.4	1.086 1.091 -0.4	1.272 1.28 -0.8	1.175 1.159 1.5	1.277 1.28 -0.4	1.085 1.094 -0.9	1.071 1.084 -1.3	0.437 0.449 -1.2			
D			0.429 0.427 0.2	0.998 0.998 0	1.084 1.076 0.8	1.291 1.295 -0.4	1.11 1.122 -1.1	1.295 1.325 -3	1.109 1.123 -1.4	1.28 1.296 -1.5	1.032 1.043 -1.1	1.01 1.019 -0.9	0.43 0.433 -0.2		
E		0.73 0.725 0.5	1.066 1.059 0.8	1.027 1.025 0.2	1.274 1.277 -0.3	1.092 1.097 -0.4	1.297 1.309 -1.2	1.094 1.11 -1.6	1.297 1.316 -1.8	1.09 1.106 -1.5	1.277 1.293 -1.6	1.087 1.087 0	1.08 1.083 -0.3	0.732 0.735 -0.3	
F		0.952 0.946 0.6	1.084 1.077 0.7	1.278 1.273 0.5	1.088 1.087 0.1	1.263 1.266 -0.3	1.054 1.061 -0.7	1.259 1.277 -1.8	1.065 1.079 -1.4	1.265 1.289 -2.4	1.093 1.102 -0.8	1.291 1.29 0.1	1.087 1.089 -0.2	0.952 0.959 -0.6	
G	0.286 0.283 0.2	0.936 0.928 0.8	1.276 1.269 0.7	1.108 1.101 0.7	1.293 1.287 0.6	1.057 1.055 0.2	1 1.003 -0.3	1.079 1.086 -0.7	1.007 1.014 -0.7	1.049 1.061 -1.1	1.294 1.298 -0.4	1.109 1.091 1.7	1.271 1.274 -0.3	0.933 0.945 -1.2	0.288 0.293 -0.5
H	0.319 0.315 0.4	0.953 0.943 1.1	1.174 1.16 1.4	1.293 1.281 1.2	1.09 1.078 1.3	1.239 1.233 0.6	1.061 1.059 0.2	0.94 0.94 -0.1	1.074 1.082 -0.8	1.243 1.264 -2.1	1.09 1.097 -0.7	1.293 1.296 -0.3	1.174 1.185 -1.1	0.953 0.985 -3.2	0.319 0.33 -1.1
K	0.288 0.284 0.4	0.933 0.919 1.4	1.271 1.253 1.8	1.11 1.098 1.1	1.294 1.289 0.5	1.047 1.041 0.6	0.999 0.993 0.6	1.074 1.07 0.4	1.003 1.005 -0.2	1.059 1.069 -1	1.293 1.301 -0.8	1.108 1.112 -0.4	1.275 1.285 -1	0.935 0.949 -1.3	0.285 0.299 -1.4
L		0.952 0.936 1.6	1.086 1.062 2.4	1.291 1.276 1.5	1.092 1.085 0.8	1.263 1.254 1	1.063 1.051 1.2	1.257 1.243 1.4	1.054 1.047 0.7	1.263 1.263 0.1	1.088 1.091 -0.3	1.278 1.281 -0.3	1.084 1.086 -0.2	0.952 0.946 0.5	
M		0.731 0.721 1	1.077 1.064 1.3	1.085 1.076 0.9	1.277 1.272 0.5	1.091 1.08 1.1	1.297 1.276 2.1	1.094 1.066 2.8	1.297 1.28 1.6	1.092 1.081 1.1	1.274 1.28 -0.7	1.027 1.03 -0.2	1.066 1.069 -0.3	0.73 0.729 0.1	
N			0.426 0.43 -0.3	1.007 1.001 0.5	1.031 1.023 0.8	1.28 1.266 1.4	1.109 1.088 2.1	1.295 1.275 2	1.11 1.099 1.1	1.291 1.283 0.8	1.083 1.082 0.1	0.998 0.998 0	0.429 0.434 -0.5		
O				0.436 0.433 0.3	1.07 1.062 0.9	1.085 1.074 1.1	1.276 1.263 1.3	1.174 1.162 1.2	1.272 1.266 0.6	1.086 1.082 0.4	1.075 1.073 0.2	0.423 0.423 0.1			
P					0.73 0.724 0.6	0.952 0.946 0.6	0.935 0.933 0.3	0.953 0.952 0.2	0.933 0.939 -0.6	0.952 0.953 -0.1	0.73 0.73 0				
R							0.285 0.297 -1.2	0.319 0.321 -0.3	0.288 0.29 -0.2						

Calculated minus Measured Average Assembly Powers, RMS difference = 1.0

Figure V1 10.4.9-14: Plant V1 EOC 20 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.317 0.319 -0.2	0.36 0.372 -1.2	0.313 0.316 -0.3						
B					0.708 0.711 -0.3	0.926 0.926 0	0.934 0.932 0.3	1.041 1.039 0.1	0.936 0.936 0	0.926 0.936 -1	0.708 0.714 -0.6				
C				0.444 0.464 -2	1.072 1.081 -0.9	1.047 1.045 0.2	1.306 1.296 0.9	1.161 1.142 1.9	1.309 1.301 0.9	1.048 1.046 0.2	1.069 1.076 -0.7	0.456 0.472 -1.6			
D			0.451 0.451 0	1.022 1.03 -0.8	1.059 1.063 -0.4	1.32 1.316 0.4	1.092 1.081 1.1	1.324 1.306 1.7	1.092 1.081 1	1.315 1.301 1.4	1.018 1.017 0.1	1.029 1.038 -0.9	0.448 0.452 -0.3		
E		0.71 0.705 0.5	1.069 1.063 0.6	1.018 1.015 0.3	1.317 1.31 0.7	1.079 1.072 0.7	1.329 1.312 1.7	1.074 1.065 1	1.329 1.322 0.7	1.077 1.072 0.6	1.315 1.313 0.2	1.059 1.064 -0.5	1.072 1.08 -0.8	0.707 0.718 -1.1	
F		0.929 0.922 0.7	1.05 1.042 0.8	1.318 1.312 0.6	1.08 1.075 0.5	1.294 1.291 0.3	1.016 1.013 0.3	1.261 1.259 0.3	1.023 1.024 0	1.292 1.291 0.1	1.078 1.077 0.1	1.319 1.319 -0.1	1.046 1.05 -0.3	0.925 0.933 -0.7	
G	0.315 0.311 0.3	0.939 0.93 0.9	1.313 1.299 1.3	1.095 1.087 0.7	1.332 1.329 0.3	1.022 1.023 0	0.925 0.937 -1.2	0.979 0.986 -0.7	0.927 0.943 -1.6	1.013 1.016 -0.3	1.328 1.328 0	1.091 1.083 0.8	1.306 1.308 -0.2	0.935 0.94 -0.6	0.317 0.32 -0.3
H	0.361 0.358 0.4	1.043 1.035 0.8	1.163 1.151 1.2	1.327 1.319 0.8	1.077 1.075 0.2	1.255 1.255 0	0.969 0.972 -0.3	0.845 0.849 -0.4	0.976 0.985 -0.9	1.255 1.258 -0.3	1.075 1.076 -0.1	1.325 1.325 0	1.162 1.166 -0.3	1.042 1.053 -1.1	0.361 0.368 -0.7
K	0.317 0.314 0.3	0.935 0.928 0.8	1.307 1.297 1	1.094 1.084 0.9	1.331 1.315 1.5	1.014 1.008 0.5	0.925 0.923 0.1	0.977 0.98 -0.3	0.926 0.942 -1.6	1.022 1.04 -1.8	1.331 1.337 -0.7	1.094 1.094 0	1.312 1.317 -0.5	0.938 0.948 -1	0.314 0.333 -1.9
L		0.926 0.921 0.5	1.047 1.039 0.8	1.32 1.313 0.7	1.08 1.072 0.8	1.294 1.288 0.6	1.024 1.018 0.6	1.262 1.257 0.5	1.016 1.018 -0.2	1.293 1.301 -0.7	1.079 1.078 0.1	1.318 1.309 0.8	1.05 1.051 -0.1	0.928 0.932 -0.4	
M		0.707 0.706 0.1	1.071 1.073 -0.2	1.06 1.058 0.2	1.317 1.312 0.5	1.08 1.074 0.6	1.33 1.32 1	1.075 1.056 1.9	1.33 1.324 0.5	1.079 1.079 0	1.317 1.31 0.7	1.018 1.016 0.3	1.069 1.074 -0.5	0.709 0.713 -0.3	
N			0.446 0.459 -1.4	1.028 1.034 -0.6	1.019 1.019 0	1.317 1.315 0.2	1.092 1.087 0.6	1.325 1.317 0.8	1.092 1.089 0.3	1.32 1.319 0.1	1.059 1.057 0.2	1.023 1.024 -0.1	0.451 0.463 -1.2		
O				0.456 0.458 -0.2	1.07 1.075 -0.5	1.049 1.051 -0.2	1.31 1.313 -0.2	1.162 1.159 0.3	1.306 1.309 -0.3	1.047 1.046 0.1	1.07 1.07 0	0.443 0.443 0			
P					0.708 0.718 -1	0.927 0.935 -0.8	0.937 0.946 -1	1.041 1.051 -1	0.935 0.948 -1.3	0.926 0.931 -0.5	0.707 0.709 -0.2				
R							0.313 0.333 -1.9	0.361 0.368 -0.7	0.317 0.322 -0.5						

Calculated minus Measured Average Assembly Powers, RMS difference = 0.8

Figure V1 10.4.9-15: Plant V1 BOC 21 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.268 0.274 -0.6	0.309 0.321 -1.2	0.261 0.269 -0.8						
B					0.798 0.799 -0.1	0.953 0.96 -0.7	0.951 0.967 -1.6	0.891 0.92 -2.9	0.96 0.985 -2.5	0.964 0.98 -1.6	0.806 0.823 -1.7				
C				0.485 0.494 -0.8	1.149 1.145 0.5	1.205 1.209 -0.4	1.223 1.237 -1.4	1.191 1.25 -5.9	1.232 1.267 -3.6	1.22 1.248 -2.8	1.159 1.187 -2.9	0.486 0.506 -2			
D			0.487 0.48 0.7	1.036 1.025 1.1	1.068 1.04 2.7	1.238 1.236 0.2	1.122 1.128 -0.6	1.098 1.09 0.8	1.125 1.143 -1.7	1.244 1.269 -2.5	1.068 1.09 -2.2	1.035 1.049 -1.4	0.485 0.487 -0.3		
E		0.807 0.795 1.2	1.161 1.139 2.1	1.07 1.062 0.8	1.2 1.207 -0.7	1.11 1.119 -0.9	1.223 1.248 -2.4	1.165 1.181 -1.6	1.217 1.239 -2.1	1.109 1.133 -2.3	1.198 1.228 -3	1.066 1.063 0.3	1.148 1.147 0.1	0.797 0.797 0	
F		0.965 0.954 1.2	1.223 1.207 1.5	1.248 1.24 0.7	1.112 1.113 -0.2	1.191 1.201 -0.9	1.064 1.082 -1.8	1.167 1.192 -2.6	1.066 1.087 -2.1	1.191 1.217 -2.6	1.11 1.122 -1.2	1.237 1.233 0.5	1.204 1.201 0.3	0.952 0.952 0	
G	0.261 0.259 0.2	0.96 0.951 0.9	1.234 1.218 1.6	1.133 1.127 0.6	1.221 1.22 0.2	1.066 1.072 -0.6	1.036 1.055 -1.9	0.928 0.943 -1.5	1.04 1.058 -1.8	1.066 1.078 -1.3	1.225 1.225 -0.1	1.121 1.099 2.3	1.222 1.217 0.6	0.95 0.952 -0.3	0.266 0.268 -0.2
H	0.307 0.306 0.1	0.888 0.887 0.1	1.191 1.21 -1.9	1.1 1.099 0.1	1.169 1.161 0.8	1.17 1.169 0.1	0.934 0.938 -0.4	0.881 0.885 -0.5	0.94 0.946 -0.6	1.172 1.183 -1	1.17 1.171 -0.1	1.1 1.096 0.4	1.191 1.194 -0.3	0.888 0.902 -1.4	0.307 0.314 -0.6
K	0.266 0.263 0.3	0.949 0.938 1.1	1.222 1.21 1.2	1.122 1.113 1	1.225 1.221 0.4	1.067 1.061 0.5	1.046 1.042 0.4	0.946 0.942 0.4	1.048 1.042 0.6	1.07 1.054 1.6	1.222 1.219 0.3	1.132 1.134 -0.2	1.234 1.24 -0.6	0.959 0.968 -0.9	0.261 0.272 -1.1
L		0.952 0.928 2.3	1.204 1.162 4.2	1.238 1.214 2.3	1.111 1.097 1.4	1.193 1.18 1.4	1.07 1.059 1.2	1.175 1.164 1.1	1.07 1.059 1	1.195 1.182 1.2	1.113 1.115 -0.2	1.248 1.259 -1.2	1.222 1.229 -0.7	0.965 0.965 0	
M		0.797 0.778 1.9	1.148 1.121 2.8	1.066 1.046 2	1.199 1.18 1.9	1.111 1.093 1.8	1.22 1.198 2.2	1.169 1.155 1.4	1.226 1.211 1.5	1.112 1.092 2	1.201 1.212 -1.1	1.07 1.079 -0.9	1.161 1.172 -1.1	0.807 0.811 -0.4	
N			0.485 0.481 0.4	1.035 1.018 1.7	1.068 1.049 1.9	1.245 1.22 2.5	1.127 1.09 3.7	1.1 1.091 0.9	1.123 1.113 1	1.24 1.224 1.6	1.068 1.066 0.3	1.037 1.042 -0.5	0.487 0.501 -1.4		
O				0.486 0.478 0.8	1.159 1.139 2	1.221 1.203 1.8	1.233 1.223 0.9	1.192 1.217 -2.5	1.224 1.219 0.5	1.206 1.182 2.4	1.15 1.138 1.2	0.486 0.484 0.2			
P					0.806 0.789 1.7	0.964 0.952 1.3	0.96 0.955 0.5	0.891 0.895 -0.3	0.951 0.943 0.8	0.953 0.94 1.3	0.798 0.789 1				
R							0.261 0.264 -0.3	0.308 0.31 -0.1	0.267 0.266 0.1						

Calculated minus Measured Average Assembly Powers, RMS difference = 1.5

Figure V1 10.4.9-16: Plant V1 MOC 21 Assembly Average Radial Power Distribution

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.289 0.292 -0.3	0.336 0.344 -0.8	0.282 0.287 -0.4						
B					0.747 0.746 0.2	0.927 0.928 0	0.938 0.943 -0.4	0.901 0.914 -1.3	0.945 0.955 -1.1	0.935 0.94 -0.5	0.752 0.76 -0.9				
C				0.485 0.494 -0.9	1.104 1.098 0.5	1.144 1.142 0.3	1.282 1.283 -0.1	1.273 1.299 -2.6	1.289 1.307 -1.7	1.154 1.168 -1.4	1.109 1.127 -1.8	0.485 0.502 -1.6			
D			0.486 0.48 0.6	1.024 1.016 0.8	1.035 1.012 2.3	1.29 1.286 0.4	1.113 1.113 0	1.086 1.071 1.5	1.114 1.121 -0.8	1.294 1.312 -1.7	1.034 1.048 -1.5	1.023 1.032 -0.9	0.485 0.486 -0.1		
E		0.752 0.742 1	1.11 1.092 1.7	1.035 1.03 0.5	1.261 1.272 -1.1	1.112 1.119 -0.7	1.286 1.309 -2.3	1.143 1.154 -1.1	1.28 1.298 -1.7	1.111 1.131 -2	1.26 1.284 -2.4	1.034 1.028 0.6	1.103 1.101 0.2	0.747 0.746 0.1	
F		0.935 0.926 0.9	1.155 1.143 1.2	1.297 1.291 0.5	1.112 1.114 -0.2	1.257 1.265 -0.8	1.051 1.064 -1.3	1.211 1.235 -2.4	1.053 1.071 -1.8	1.257 1.293 -3.6	1.112 1.125 -1.3	1.29 1.287 0.3	1.144 1.14 0.4	0.926 0.925 0.1	
G	0.282 0.28 0.2	0.944 0.936 0.8	1.29 1.277 1.3	1.119 1.113 0.6	1.283 1.281 0.2	1.052 1.054 -0.1	0.999 1.004 -0.5	0.893 0.901 -0.8	1.001 1.008 -0.7	1.052 1.067 -1.5	1.287 1.292 -0.6	1.112 1.094 1.8	1.281 1.276 0.5	0.937 0.937 0	0.288 0.288 -0.1
H	0.334 0.333 0.2	0.897 0.894 0.3	1.272 1.281 -0.9	1.087 1.084 0.3	1.145 1.139 0.6	1.213 1.212 0.1	0.897 0.897 0	0.839 0.841 -0.2	0.901 0.907 -0.5	1.215 1.235 -2	1.145 1.151 -0.6	1.086 1.085 0.1	1.272 1.275 -0.3	0.898 0.904 -0.5	0.335 0.339 -0.4
K	0.287 0.284 0.3	0.936 0.927 1	1.281 1.269 1.1	1.112 1.105 0.7	1.287 1.287 0	1.052 1.049 0.4	1.005 1.001 0.4	0.905 0.902 0.3	1.006 1.002 0.3	1.054 1.045 0.9	1.283 1.286 -0.4	1.118 1.124 -0.6	1.29 1.298 -0.8	0.944 0.951 -0.7	0.282 0.293 -1.1
L		0.926 0.909 1.7	1.144 1.111 3.2	1.29 1.274 1.6	1.112 1.105 0.7	1.258 1.25 0.8	1.055 1.046 0.8	1.216 1.208 0.7	1.054 1.048 0.6	1.259 1.254 0.5	1.112 1.118 -0.6	1.296 1.316 -2	1.155 1.165 -1	0.935 0.936 -0.2	
M		0.747 0.735 1.2	1.103 1.088 1.5	1.034 1.024 1	1.26 1.253 0.7	1.111 1.1 1.1	1.281 1.265 1.6	1.144 1.134 1	1.287 1.277 1	1.112 1.101 1.1	1.261 1.273 -1.2	1.034 1.045 -1.1	1.11 1.124 -1.5	0.752 0.758 -0.6	
N			0.485 0.492 -0.7	1.023 1.018 0.5	1.034 1.024 0.9	1.295 1.278 1.7	1.114 1.086 2.8	1.086 1.078 0.9	1.113 1.103 0.9	1.291 1.278 1.2	1.035 1.033 0.2	1.024 1.03 -0.6	0.486 0.502 -1.7		
O				0.485 0.482 0.4	1.109 1.098 1.1	1.154 1.142 1.1	1.289 1.281 0.9	1.273 1.285 -1.2	1.282 1.273 0.8	1.144 1.122 2.2	1.104 1.093 1.1	0.485 0.484 0.1			
P					0.751 0.741 1	0.935 0.927 0.8	0.944 0.941 0.3	0.901 0.901 0	0.938 0.928 1	0.927 0.914 1.3	0.747 0.739 0.9				
R							0.282 0.287 -0.5	0.336 0.336 -0.1	0.288 0.286 0.2						

Calculated power
Measured power
Difference (C-M)*100

Calculated minus Measured Average Assembly Powers, RMS difference = 1.1

Figure V1 10.4.9-17: Plant V1 EOC 21 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.311 0.313 -0.2	0.361 0.372 -1.1	0.304 0.306 -0.2						
B					0.731 0.734 -0.2	0.932 0.931 0.1	0.924 0.92 0.4	0.893 0.887 0.6	0.925 0.921 0.4	0.933 0.935 -0.2	0.731 0.734 -0.3				
C				0.507 0.53 -2.3	1.102 1.109 -0.7	1.098 1.096 0.2	1.321 1.312 0.9	1.325 1.299 2.6	1.321 1.31 1.2	1.097 1.094 0.3	1.102 1.107 -0.5	0.507 0.524 -1.8			
D			0.506 0.509 -0.3	1.052 1.062 -1	1.02 1.016 0.4	1.326 1.325 0.2	1.082 1.078 0.5	1.045 1.035 1	1.08 1.073 0.7	1.326 1.32 0.5	1.018 1.015 0.3	1.052 1.056 -0.4	0.507 0.507 0		
E		0.73 0.733 -0.3	1.101 1.105 -0.4	1.017 1.022 -0.5	1.317 1.324 -0.7	1.1 1.101 -0.2	1.322 1.323 -0.1	1.103 1.099 0.4	1.318 1.312 0.6	1.098 1.094 0.4	1.318 1.3 1.7	1.02 1.016 0.4	1.102 1.098 0.4	0.731 0.729 0.3	
F		0.932 0.936 -0.4	1.097 1.101 -0.4	1.325 1.332 -0.7	1.098 1.103 -0.5	1.305 1.308 -0.3	1.029 1.029 0	1.257 1.255 0.2	1.03 1.028 0.2	1.305 1.309 -0.4	1.1 1.093 0.7	1.327 1.316 1.1	1.098 1.091 0.7	0.932 0.928 0.4	
G	0.304 0.304 -0.1	0.924 0.927 -0.2	1.321 1.329 -0.8	1.083 1.088 -0.5	1.318 1.326 -0.8	1.029 1.032 -0.3	0.951 0.951 0	0.856 0.853 0.3	0.953 0.944 0.8	1.028 1.024 0.5	1.322 1.311 1.1	1.082 1.064 1.8	1.32 1.311 0.9	0.923 0.921 0.2	0.31 0.31 0
H	0.36 0.359 0.1	0.89 0.887 0.3	1.324 1.315 0.9	1.045 1.047 -0.2	1.103 1.115 -1.2	1.257 1.263 -0.6	0.858 0.858 -0.1	0.795 0.794 0.2	0.861 0.855 0.5	1.257 1.249 0.8	1.103 1.096 0.7	1.044 1.037 0.7	1.324 1.321 0.4	0.891 0.894 -0.3	0.36 0.364 -0.4
K	0.309 0.308 0.1	0.923 0.92 0.2	1.32 1.316 0.4	1.082 1.083 -0.1	1.322 1.325 -0.3	1.028 1.031 -0.3	0.954 0.954 0	0.863 0.86 0.3	0.954 0.949 0.5	1.029 1.02 0.9	1.317 1.311 0.6	1.082 1.08 0.2	1.321 1.32 0	0.924 0.927 -0.3	0.304 0.315 -1.2
L		0.931 0.931 0	1.098 1.094 0.4	1.326 1.33 -0.4	1.1 1.104 -0.4	1.305 1.308 -0.3	1.029 1.029 0.1	1.257 1.253 0.4	1.028 1.023 0.5	1.304 1.296 0.9	1.097 1.095 0.2	1.325 1.33 -0.6	1.097 1.098 -0.1	0.932 0.928 0.4	
M		0.731 0.735 -0.4	1.102 1.113 -1.1	1.02 1.028 -0.9	1.317 1.329 -1.2	1.098 1.101 -0.3	1.317 1.316 0.1	1.102 1.098 0.4	1.321 1.314 0.7	1.099 1.088 1.1	1.316 1.314 0.2	1.017 1.018 -0.1	1.101 1.108 -0.7	0.73 0.732 -0.2	
N			0.507 0.53 -2.3	1.052 1.068 -1.6	1.017 1.025 -0.8	1.325 1.329 -0.4	1.08 1.075 0.5	1.044 1.039 0.5	1.082 1.077 0.5	1.326 1.319 0.7	1.019 1.016 0.3	1.051 1.047 0.4	0.506 0.523 -1.7		
O				0.506 0.512 -0.5	1.101 1.11 -0.8	1.097 1.1 -0.3	1.321 1.32 0.1	1.325 1.317 0.8	1.32 1.317 0.3	1.097 1.094 0.3	1.101 1.098 0.3	0.507 0.505 0.2			
P					0.731 0.738 -0.7	0.932 0.938 -0.6	0.925 0.93 -0.5	0.893 0.894 -0.2	0.923 0.929 -0.6	0.931 0.932 -0.1	0.731 0.73 0.1				
R							0.304 0.317 -1.3	0.36 0.365 -0.4	0.31 0.313 -0.2						

Calculated minus Measured Average Assembly Powers, RMS difference = 0.7

Figure V1 10.4.9-18: Plant V1 BOC 22 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.257 0.264 -0.7	0.293 0.31 -1.7	0.258 0.266 -0.8						
B					0.805 0.805 0	0.968 0.976 -0.8	0.942 0.96 -1.8	0.852 0.872 -2	0.956 0.976 -2	0.983 0.997 -1.4	0.817 0.835 -1.8				
C				0.482 0.493 -1	1.149 1.141 0.8	1.201 1.208 -0.7	1.213 1.239 -2.6	1.184 1.207 -2.4	1.231 1.259 -2.8	1.226 1.256 -3	1.163 1.197 -3.4	0.486 0.513 -2.7			
D			0.487 0.479 0.7	1.031 1.016 1.5	1.058 1.016 4.2	1.229 1.23 -0.1	1.117 1.139 -2.1	1.098 1.125 -2.7	1.141 1.172 -3.1	1.245 1.281 -3.6	1.065 1.096 -3.1	1.029 1.044 -1.5	0.482 0.484 -0.2		
E		0.817 0.803 1.4	1.164 1.144 2	1.067 1.062 0.5	1.191 1.21 -1.9	1.105 1.121 -1.7	1.221 1.257 -3.6	1.165 1.201 -3.6	1.221 1.259 -3.8	1.106 1.146 -4	1.189 1.237 -4.8	1.057 1.043 1.4	1.148 1.138 0.9	0.805 0.798 0.6	
F		0.984 0.966 1.8	1.227 1.208 1.9	1.246 1.239 0.8	1.108 1.115 -0.7	1.193 1.209 -1.6	1.077 1.105 -2.8	1.182 1.226 -4.5	1.075 1.109 -3.4	1.189 1.24 -5.1	1.103 1.128 -2.5	1.228 1.222 0.6	1.2 1.191 0.9	0.967 0.959 0.7	
G	0.258 0.253 0.5	0.956 0.936 2	1.232 1.205 2.7	1.141 1.132 0.9	1.223 1.227 -0.3	1.08 1.092 -1.1	1.062 1.083 -2	0.984 1.004 -2.1	1.052 1.063 -1.1	1.072 1.101 -2.9	1.218 1.231 -1.3	1.116 1.093 2.2	1.212 1.201 1.1	0.941 0.935 0.6	0.256 0.256 0
H	0.292 0.286 0.7	0.853 0.833 1.9	1.184 1.168 1.6	1.099 1.09 0.9	1.167 1.171 -0.4	1.187 1.195 -0.7	0.997 1.007 -1	0.905 0.918 -1.2	0.978 0.995 -1.7	1.178 1.227 -4.8	1.163 1.181 -1.8	1.096 1.098 -0.1	1.182 1.181 0.1	0.851 0.847 0.5	0.292 0.295 -0.4
K	0.256 0.248 0.8	0.942 0.909 3.3	1.213 1.173 4	1.118 1.101 1.7	1.222 1.235 -1.3	1.079 1.082 -0.3	1.065 1.067 -0.1	0.991 0.992 -0.1	1.056 1.057 -0.2	1.075 1.069 0.6	1.219 1.229 -1	1.139 1.149 -1.1	1.23 1.24 -1	0.955 0.966 -1.1	0.258 0.278 -2
L		0.968 0.919 4.9	1.201 1.123 7.8	1.229 1.192 3.7	1.105 1.094 1.1	1.193 1.182 1.1	1.08 1.07 1	1.184 1.174 1	1.075 1.068 0.8	1.19 1.183 0.7	1.105 1.119 -1.4	1.244 1.267 -2.3	1.225 1.243 -1.7	0.983 0.995 -1.2	
M		0.805 0.769 3.7	1.148 1.101 4.7	1.057 1.03 2.7	1.191 1.175 1.6	1.107 1.089 1.8	1.222 1.196 2.6	1.165 1.147 1.8	1.22 1.201 1.9	1.103 1.081 2.2	1.189 1.222 -3.3	1.065 1.086 -2.1	1.163 1.183 -2.1	0.816 0.829 -1.3	
N			0.482 0.481 0.1	1.03 1.009 2.1	1.066 1.044 2.2	1.245 1.213 3.2	1.139 1.095 4.5	1.097 1.077 2.1	1.116 1.096 2	1.228 1.203 2.5	1.057 1.057 0	1.03 1.042 -1.3	0.486 0.501 -1.4		
O				0.486 0.476 1.1	1.163 1.134 2.9	1.226 1.197 2.9	1.23 1.205 2.5	1.183 1.178 0.5	1.212 1.189 2.3	1.2 1.152 4.8	1.148 1.125 2.3	0.482 0.48 0.2			
P					0.816 0.789 2.8	0.983 0.96 2.3	0.955 0.942 1.3	0.852 0.845 0.6	0.942 0.934 0.8	0.967 0.942 2.5	0.805 0.787 1.8				
R							0.258 0.268 -1	0.293 0.294 -0.1	0.256 0.255 0.1						

Calculated minus Measured Average Assembly Powers, RMS difference = 2.2

Figure V1 10.4.9-19: Plant V1 MOC 22 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.284 0.288 -0.4	0.329 0.339 -0.9	0.284 0.289 -0.5						
B					0.742 0.742 0	0.935 0.938 -0.3	0.933 0.941 -0.8	0.876 0.888 -1.2	0.938 0.952 -1.4	0.938 0.949 -1.1	0.744 0.758 -1.4				
C				0.484 0.495 -1.1	1.096 1.092 0.4	1.139 1.141 -0.2	1.29 1.299 -0.9	1.284 1.303 -1.9	1.298 1.321 -2.3	1.143 1.165 -2.2	1.1 1.126 -2.6	0.486 0.505 -1.9			
D			0.486 0.483 0.3	1.016 1.011 0.6	1.024 0.997 2.7	1.297 1.297 0	1.109 1.121 -1.2	1.083 1.101 -1.8	1.123 1.146 -2.3	1.303 1.334 -3.1	1.026 1.051 -2.5	1.016 1.03 -1.4	0.484 0.487 -0.3		
E		0.744 0.738 0.6	1.1 1.093 0.7	1.026 1.027 -0.1	1.265 1.286 -2.1	1.107 1.12 -1.2	1.295 1.321 -2.6	1.136 1.16 -2.4	1.293 1.324 -3.1	1.107 1.142 -3.4	1.265 1.308 -4.3	1.023 1.017 0.6	1.096 1.094 0.2	0.742 0.741 0.1	
F		0.938 0.927 1.1	1.143 1.131 1.2	1.303 1.3 0.3	1.107 1.114 -0.6	1.268 1.279 -1.1	1.055 1.07 -1.5	1.227 1.257 -3	1.054 1.078 -2.4	1.266 1.32 -5.4	1.107 1.132 -2.5	1.296 1.299 -0.3	1.139 1.137 0.2	0.935 0.932 0.2	
G	0.284 0.279 0.5	0.938 0.923 1.5	1.298 1.272 2.6	1.123 1.115 0.8	1.294 1.295 -0.2	1.056 1.06 -0.4	1.003 1.007 -0.4	0.927 0.934 -0.7	0.998 0.993 0.5	1.053 1.074 -2.1	1.294 1.309 -1.5	1.109 1.099 0.9	1.29 1.286 0.4	0.933 0.929 0.4	0.284 0.284 0.1
H	0.329 0.323 0.5	0.876 0.863 1.3	1.284 1.276 0.8	1.083 1.077 0.6	1.136 1.138 -0.2	1.23 1.232 -0.2	0.935 0.937 -0.1	0.845 0.848 -0.3	0.924 0.93 -0.6	1.225 1.258 -3.3	1.135 1.149 -1.4	1.083 1.087 -0.4	1.284 1.285 -0.1	0.876 0.868 0.8	0.328 0.33 -0.1
K	0.284 0.278 0.6	0.933 0.91 2.3	1.29 1.261 2.9	1.109 1.097 1.2	1.295 1.305 -1	1.056 1.055 0	1.005 1.002 0.3	0.932 0.929 0.3	1 0.999 0.1	1.054 1.051 0.3	1.292 1.303 -1.1	1.122 1.133 -1.1	1.297 1.308 -1	0.938 0.945 -0.7	0.284 0.296 -1.3
L		0.935 0.9 3.4	1.139 1.081 5.7	1.296 1.269 2.7	1.108 1.101 0.7	1.268 1.258 0.9	1.056 1.046 1	1.228 1.218 1	1.054 1.048 0.7	1.267 1.264 0.2	1.107 1.12 -1.3	1.303 1.329 -2.6	1.143 1.158 -1.5	0.938 0.948 -1	
M		0.742 0.718 2.4	1.096 1.064 3.1	1.023 1.006 1.7	1.265 1.259 0.6	1.107 1.093 1.4	1.293 1.27 2.3	1.136 1.12 1.6	1.295 1.279 1.5	1.107 1.095 1.2	1.265 1.292 -2.7	1.026 1.044 -1.8	1.1 1.118 -1.8	0.744 0.755 -1.1	
N			0.484 0.485 -0.1	1.016 1.003 1.3	1.026 1.012 1.4	1.303 1.276 2.6	1.122 1.083 3.9	1.083 1.063 1.9	1.108 1.09 1.8	1.296 1.275 2.1	1.023 1.023 0	1.016 1.03 -1.4	0.486 0.497 -1.1		
O				0.486 0.478 0.8	1.099 1.079 2	1.142 1.12 2.2	1.297 1.273 2.4	1.284 1.273 1.1	1.29 1.266 2.4	1.139 1.097 4.2	1.096 1.077 1.9	0.484 0.483 0.1			
P					0.744 0.725 1.9	0.938 0.92 1.8	0.938 0.925 1.3	0.876 0.866 1	0.933 0.92 1.3	0.935 0.911 2.3	0.742 0.727 1.5				
R							0.284 0.289 -0.6	0.329 0.328 0.2	0.284 0.281 0.3						

Calculated minus Measured Average Assembly Powers, RMS difference = 1.7

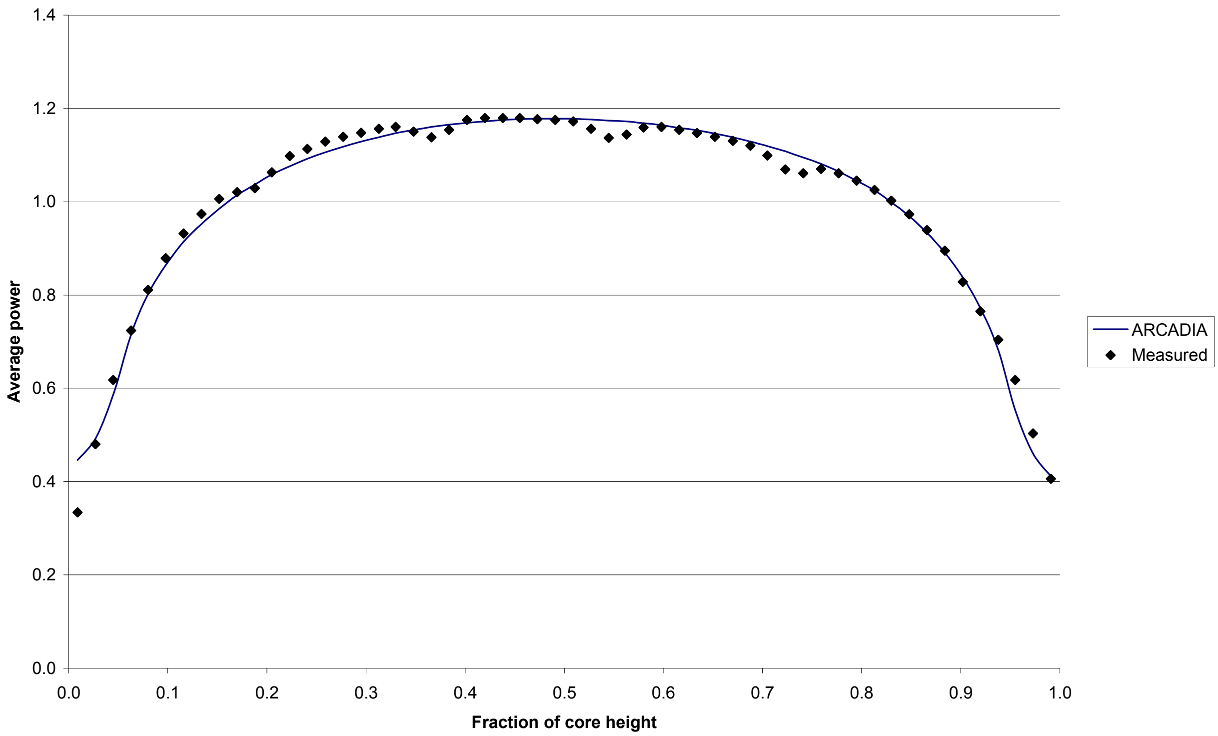
Figure V1 10.4.9-20: Plant V1 EOC 22 Assembly Average Radial Power Distribution

Calculated power
Measured power
Difference (C-M)*100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A							0.292 0.293 -0.1	0.338 0.346 -0.8	0.29 0.292 -0.2						
B					0.715 0.719 -0.4	0.922 0.923 0	0.917 0.914 0.3	0.871 0.87 0.2	0.919 0.92 -0.1	0.923 0.929 -0.7	0.714 0.721 -0.6				
C				0.486 0.512 -2.6	1.082 1.092 -1.1	1.104 1.104 0	1.333 1.321 1.2	1.343 1.332 1.1	1.335 1.332 0.3	1.103 1.106 -0.3	1.082 1.092 -1	0.487 0.508 -2.1			
D			0.487 0.494 -0.8	1.019 1.036 -1.7	1.011 1.013 -0.2	1.337 1.338 -0.1	1.096 1.092 0.4	1.06 1.055 0.4	1.104 1.102 0.3	1.339 1.338 0.1	1.012 1.013 -0.1	1.02 1.023 -0.4	0.486 0.484 0.2		
E		0.714 0.722 -0.8	1.082 1.098 -1.6	1.011 1.023 -1.2	1.321 1.336 -1.5	1.109 1.114 -0.4	1.338 1.336 0.2	1.113 1.111 0.2	1.335 1.331 0.4	1.108 1.105 0.4	1.322 1.313 0.9	1.011 1.002 0.9	1.082 1.069 1.3	0.715 0.705 1	
F		0.922 0.929 -0.6	1.102 1.109 -0.7	1.338 1.348 -1	1.108 1.116 -0.8	1.318 1.325 -0.7	1.038 1.041 -0.3	1.261 1.261 0	1.038 1.034 0.4	1.319 1.312 0.7	1.11 1.1 1	1.338 1.318 2	1.105 1.086 1.8	0.923 0.906 1.6	
G	0.29 0.291 -0.1	0.919 0.922 -0.3	1.335 1.333 0.1	1.104 1.109 -0.5	1.335 1.344 -0.9	1.038 1.045 -0.7	0.955 0.965 -1	0.881 0.881 -0.1	0.952 0.944 0.7	1.038 1.031 0.7	1.339 1.322 1.6	1.096 1.071 2.6	1.334 1.307 2.7	0.918 0.897 2.1	0.292 0.285 0.6
H	0.338 0.339 -0.1	0.871 0.876 -0.5	1.343 1.357 -1.4	1.059 1.066 -0.7	1.113 1.12 -0.8	1.262 1.271 -0.8	0.886 0.891 -0.5	0.79 0.791 -0.1	0.879 0.876 0.3	1.261 1.259 0.2	1.113 1.103 1	1.06 1.044 1.6	1.344 1.318 2.5	0.872 0.844 2.8	0.338 0.331 0.6
K	0.292 0.292 -0.1	0.917 0.92 -0.3	1.333 1.338 -0.5	1.095 1.101 -0.6	1.338 1.349 -1.1	1.038 1.044 -0.6	0.956 0.959 -0.3	0.884 0.884 0	0.953 0.949 0.4	1.038 1.029 0.9	1.336 1.324 1.1	1.104 1.093 1.1	1.336 1.319 1.6	0.92 0.908 1.2	0.29 0.298 -0.8
L		0.922 0.922 0	1.104 1.097 0.7	1.337 1.341 -0.4	1.109 1.115 -0.6	1.318 1.324 -0.6	1.038 1.04 -0.2	1.262 1.261 0.1	1.038 1.034 0.4	1.319 1.311 0.8	1.108 1.102 0.6	1.339 1.332 0.7	1.103 1.096 0.7	0.923 0.915 0.7	
M		0.715 0.718 -0.3	1.081 1.09 -0.8	1.01 1.018 -0.7	1.321 1.331 -1	1.108 1.112 -0.5	1.335 1.337 -0.2	1.113 1.111 0.2	1.338 1.333 0.5	1.11 1.103 0.6	1.322 1.317 0.5	1.012 1.015 -0.3	1.083 1.084 -0.1	0.715 0.713 0.2	
N			0.486 0.507 -2.1	1.019 1.034 -1.5	1.011 1.019 -0.8	1.338 1.345 -0.6	1.103 1.103 0	1.059 1.057 0.2	1.096 1.09 0.5	1.338 1.327 1	1.011 1.011 0	1.02 1.042 -2.2	0.487 0.498 -1.1		
O				0.487 0.492 -0.5	1.082 1.091 -0.9	1.102 1.108 -0.6	1.335 1.339 -0.4	1.343 1.342 0.1	1.333 1.327 0.7	1.104 1.082 2.2	1.082 1.074 0.8	0.486 0.49 -0.3			
P					0.714 0.723 -0.8	0.923 0.93 -0.8	0.919 0.927 -0.7	0.872 0.875 -0.3	0.918 0.922 -0.5	0.923 0.915 0.7	0.715 0.71 0.5				
R							0.29 0.303 -1.3	0.338 0.342 -0.4	0.292 0.294 -0.2						

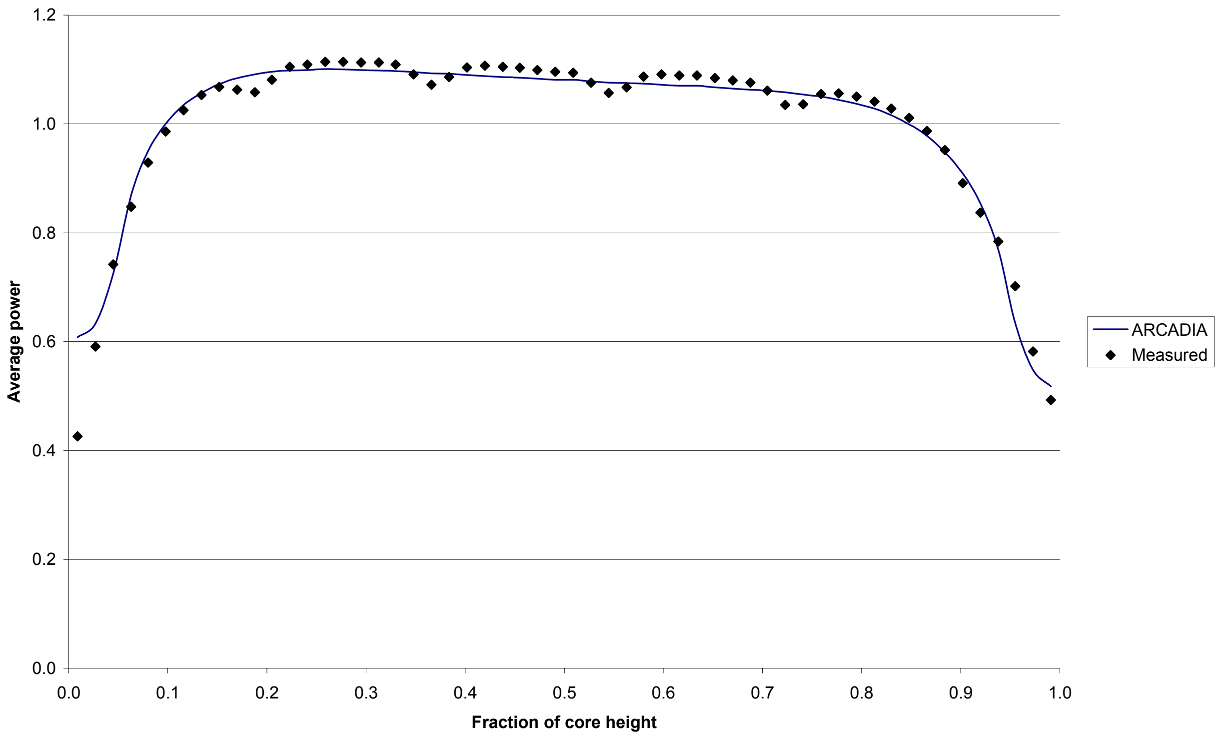
Calculated minus Measured Average Assembly Powers, RMS difference = 0.9

Figure V1 10.4.9-21: Plant V1 BOC 18 Core Average Axial Power Distribution



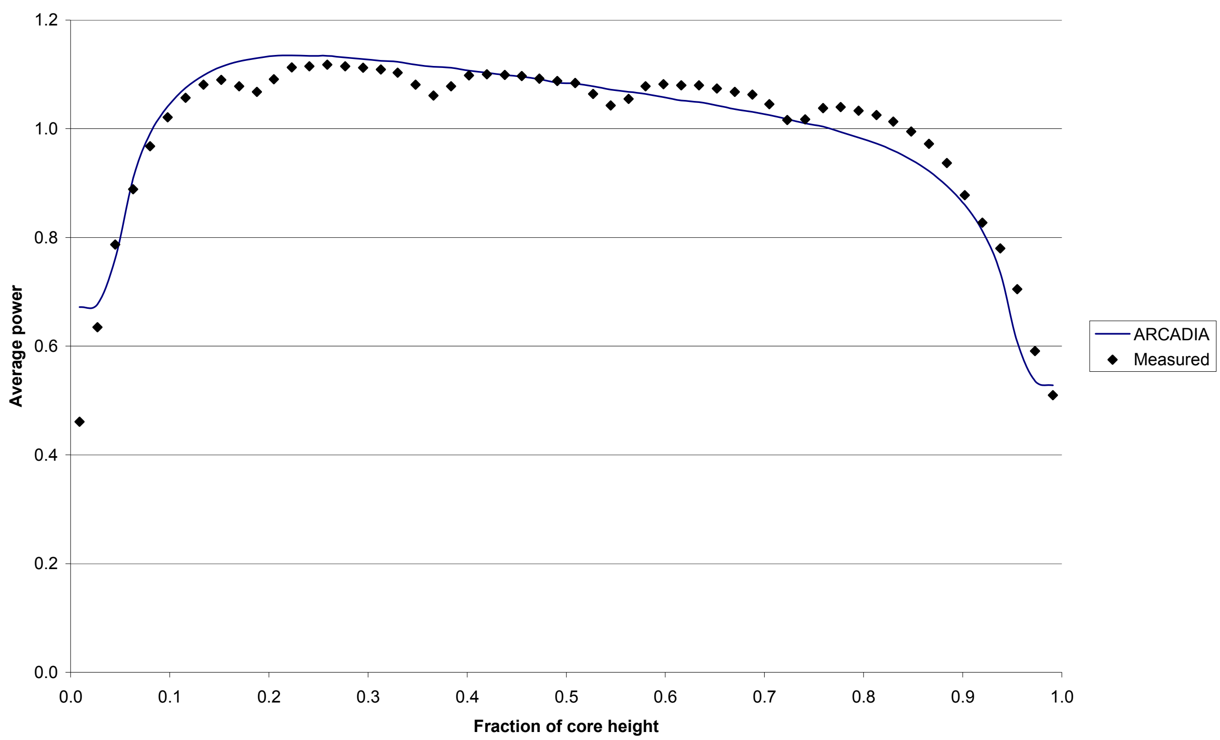
Calculated minus Measured Average Core Axial Powers, RMS difference = 2.4

Figure V1 10.4.9-22: Plant V1 MOC 18 Core Average Axial Power Distribution



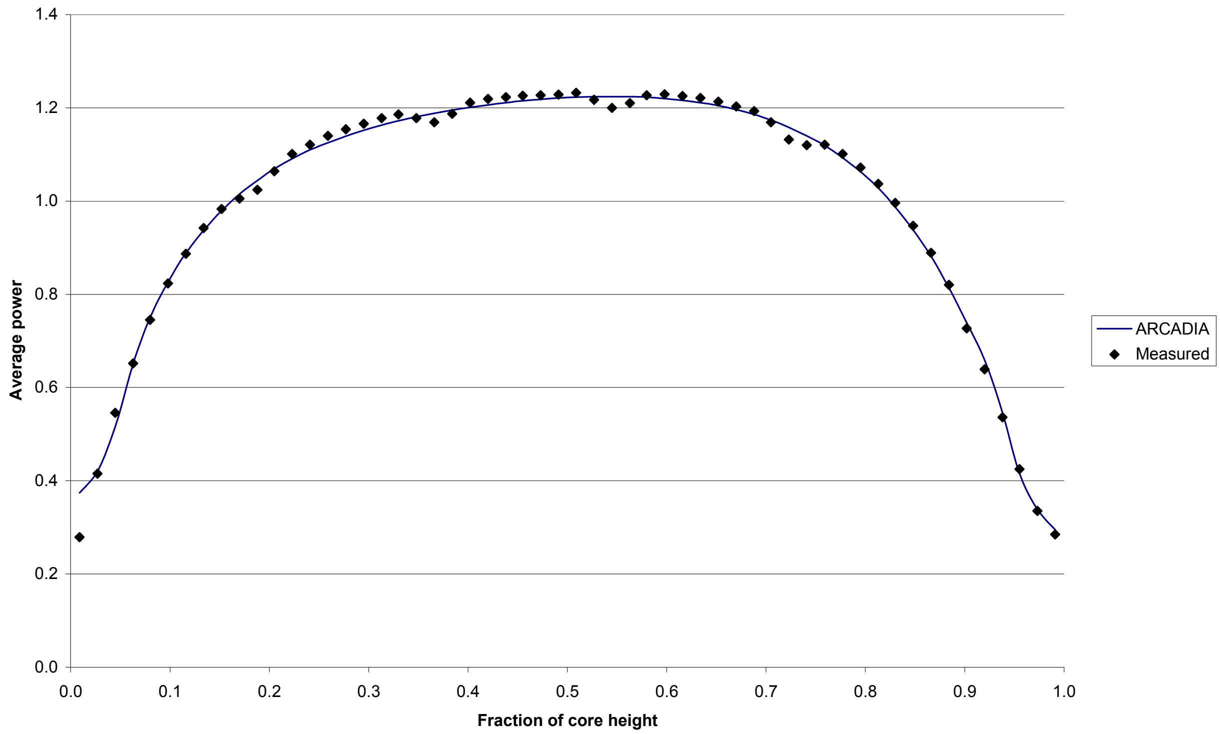
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.1

Figure V1 10.4.9-23: Plant V1 EOC 18 Core Average Axial Power Distribution



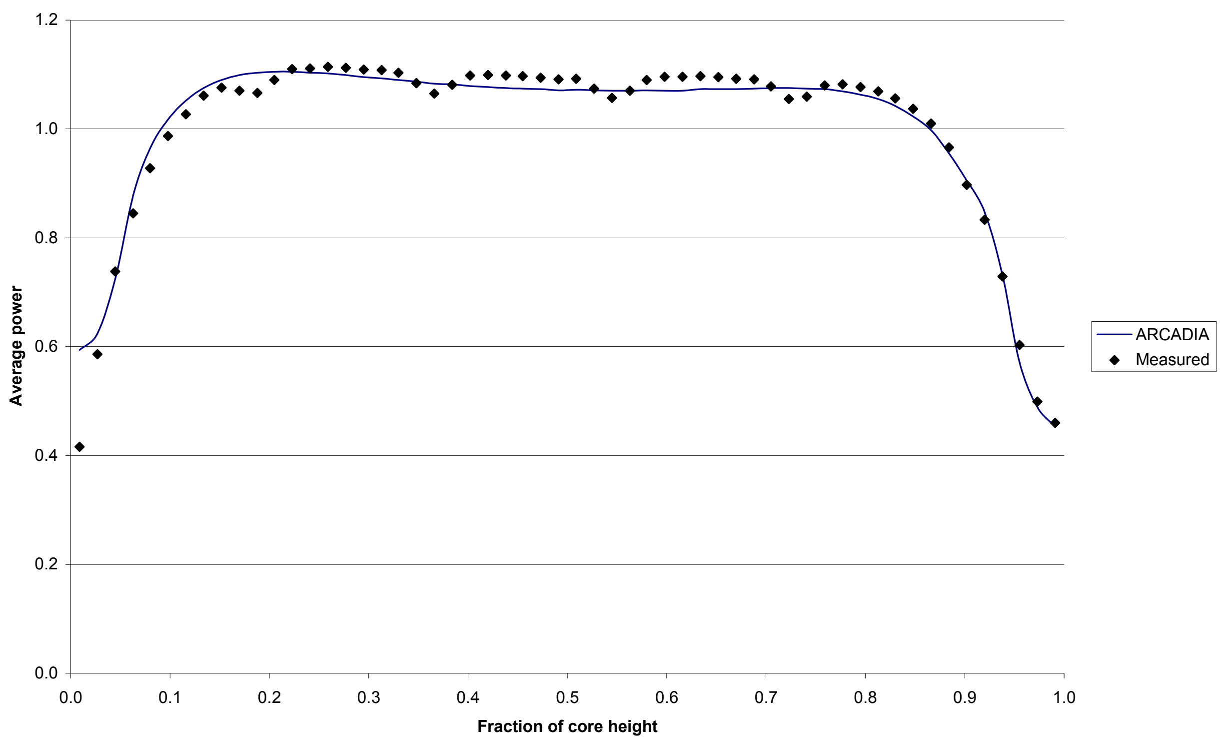
Calculated minus Measured Average Core Axial Powers, RMS difference = 4.3

Figure V1 10.4.9-24: Plant V1 BOC 19 Core Average Axial Power Distribution



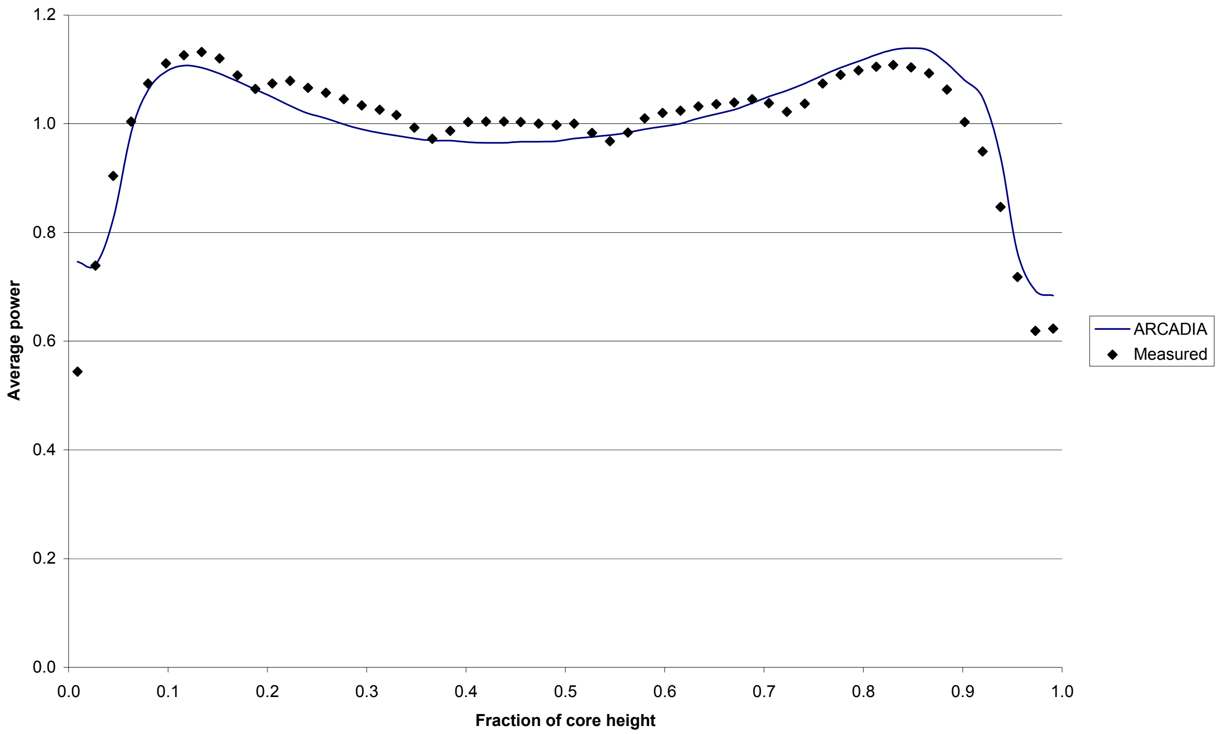
Calculated minus Measured Average Core Axial Powers, RMS difference = 1.7

Figure V1 10.4.9-25: Plant V1 MOC 19 Core Average Axial Power Distribution



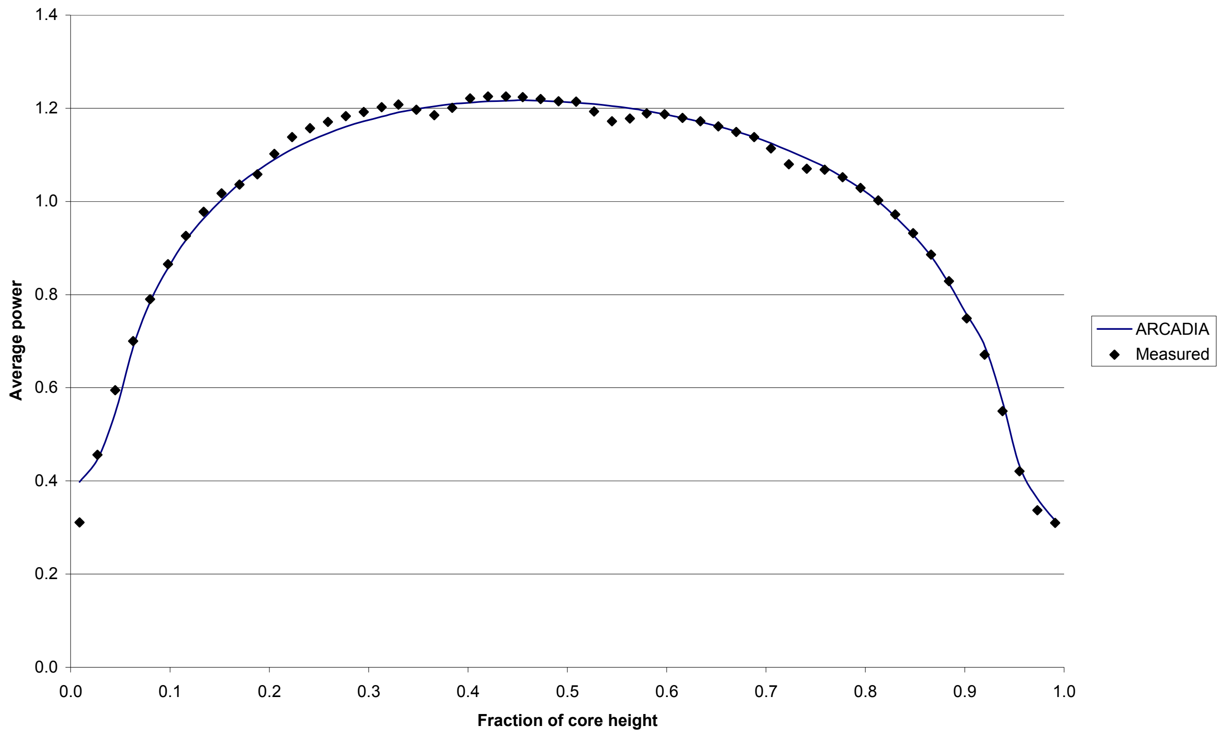
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.0

Figure V1 10.4.9-26: Plant V1 EOC 19 Core Average Axial Power Distribution



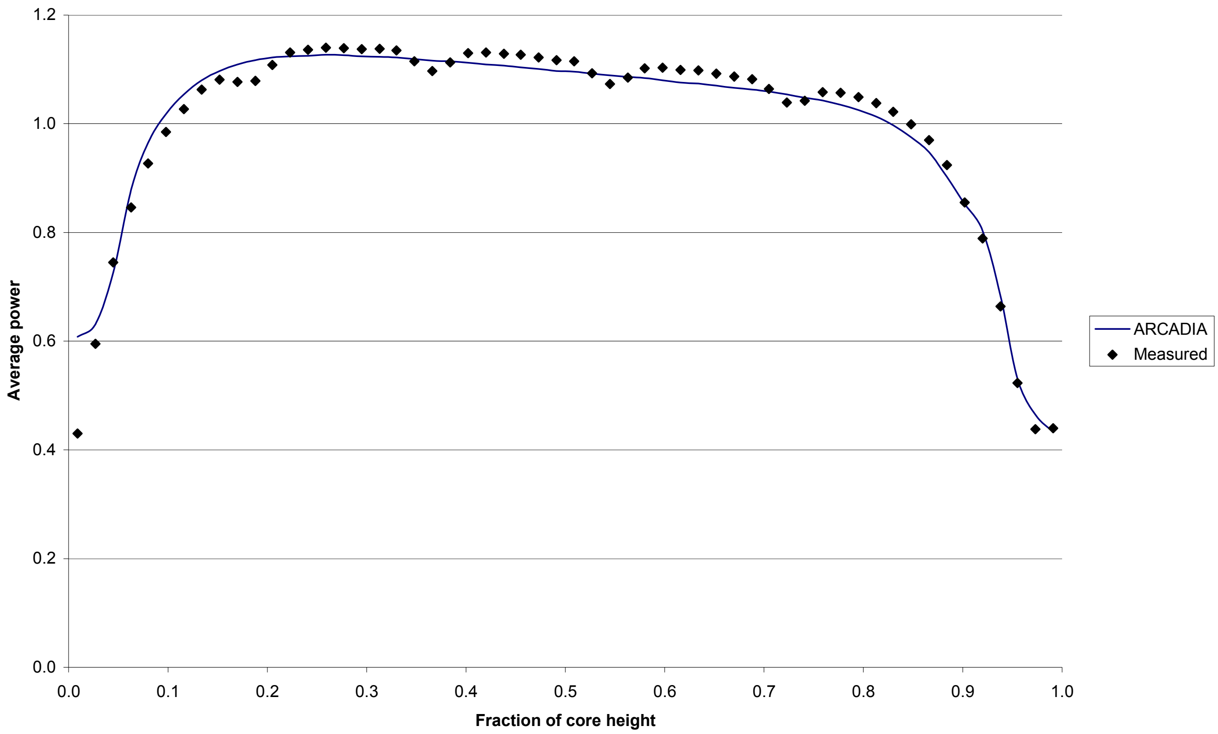
Calculated minus Measured Average Core Axial Powers, RMS difference = 4.7

Figure V1 10.4.9-27: Plant V1 BOC 20 Core Average Axial Power Distribution



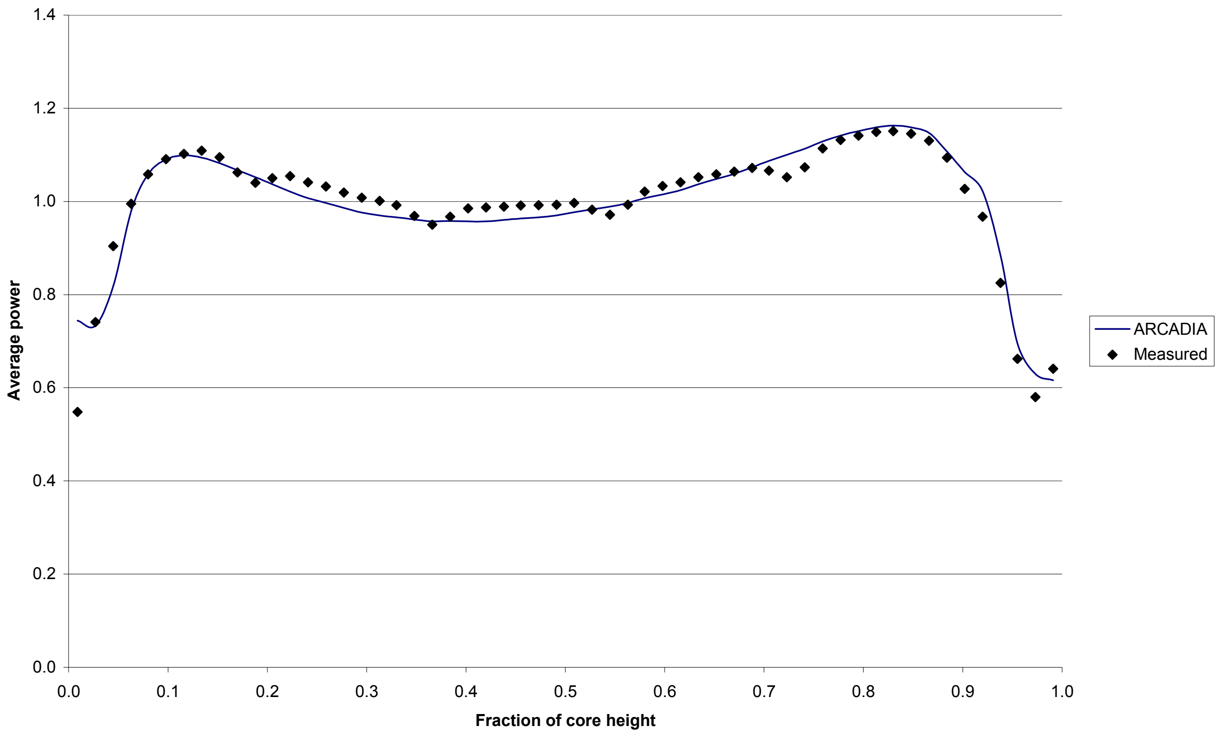
Calculated minus Measured Average Core Axial Powers, RMS difference = 1.9

Figure V1 10.4.9-28: Plant V1 MOC 20 Core Average Axial Power Distribution



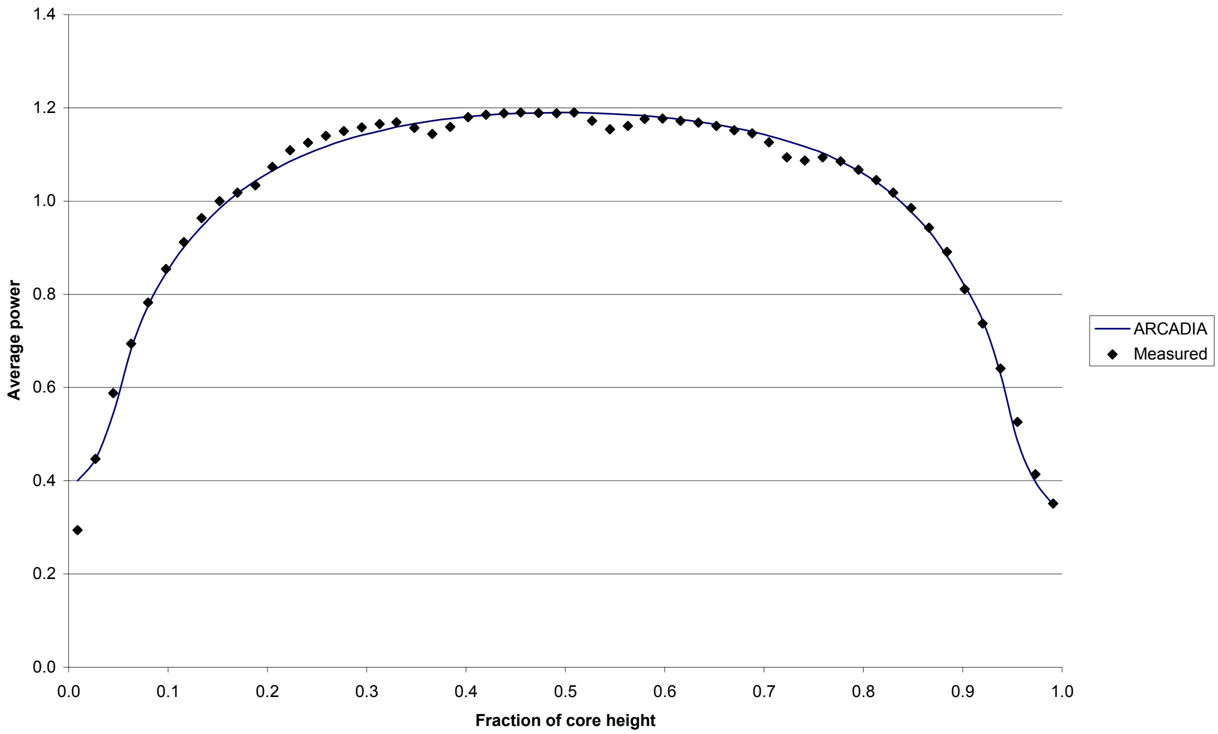
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.1

Figure V1 10.4.9-29: Plant V1 EOC 20 Core Average Axial Power Distribution



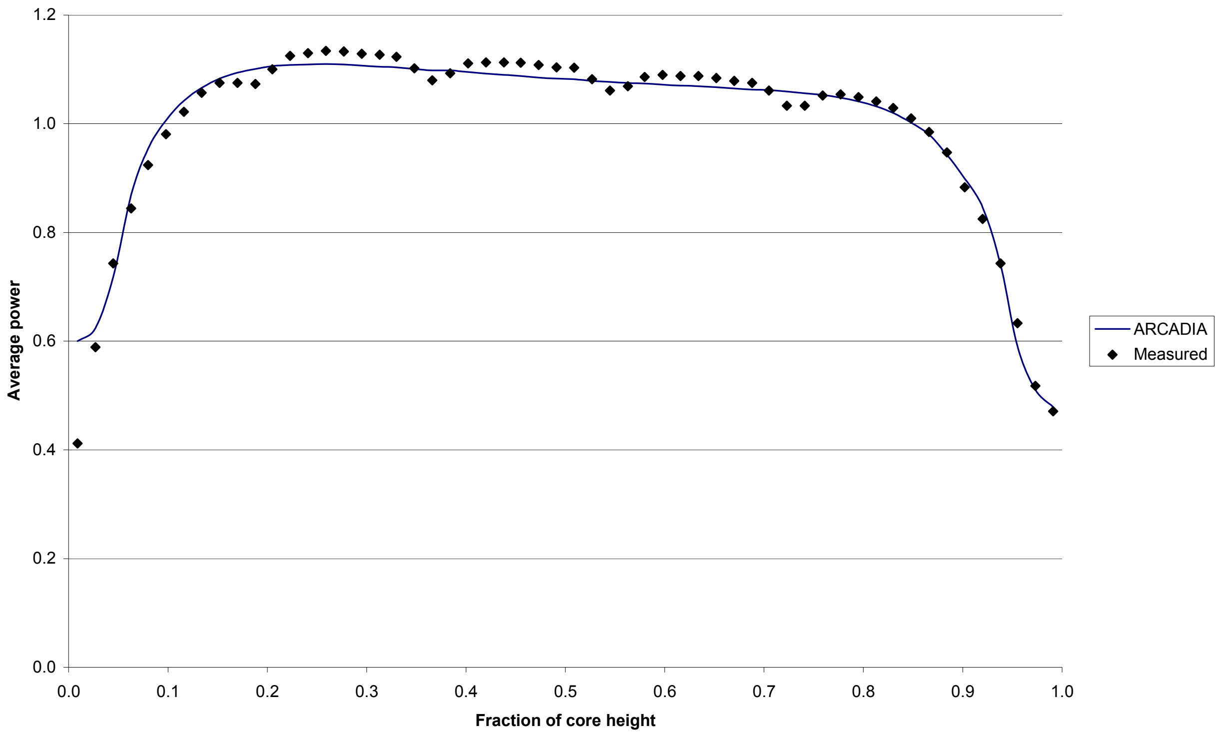
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.7

Figure V1 10.4.9-30: Plant V1 BOC 21 Core Average Axial Power Distribution



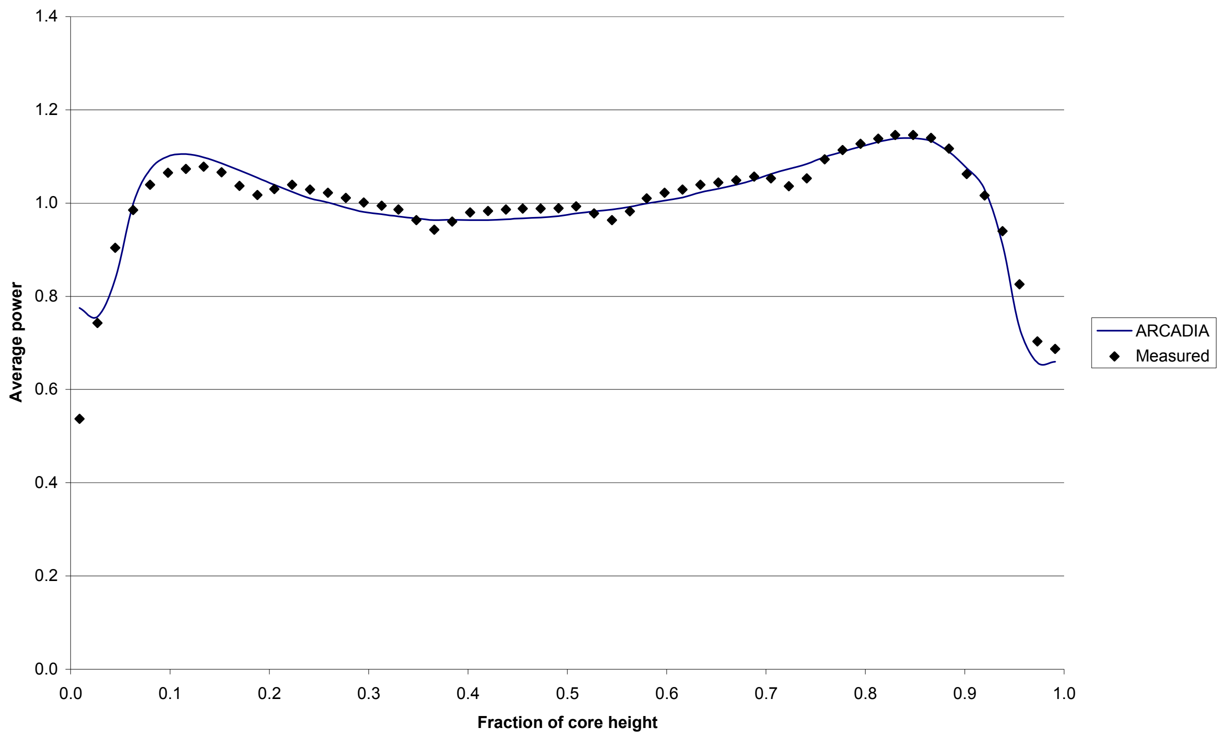
Calculated minus Measured Average Core Axial Powers, RMS difference = 2.1

Figure V1 10.4.9-31: Plant V1 MOC 21 Core Average Axial Power Distribution



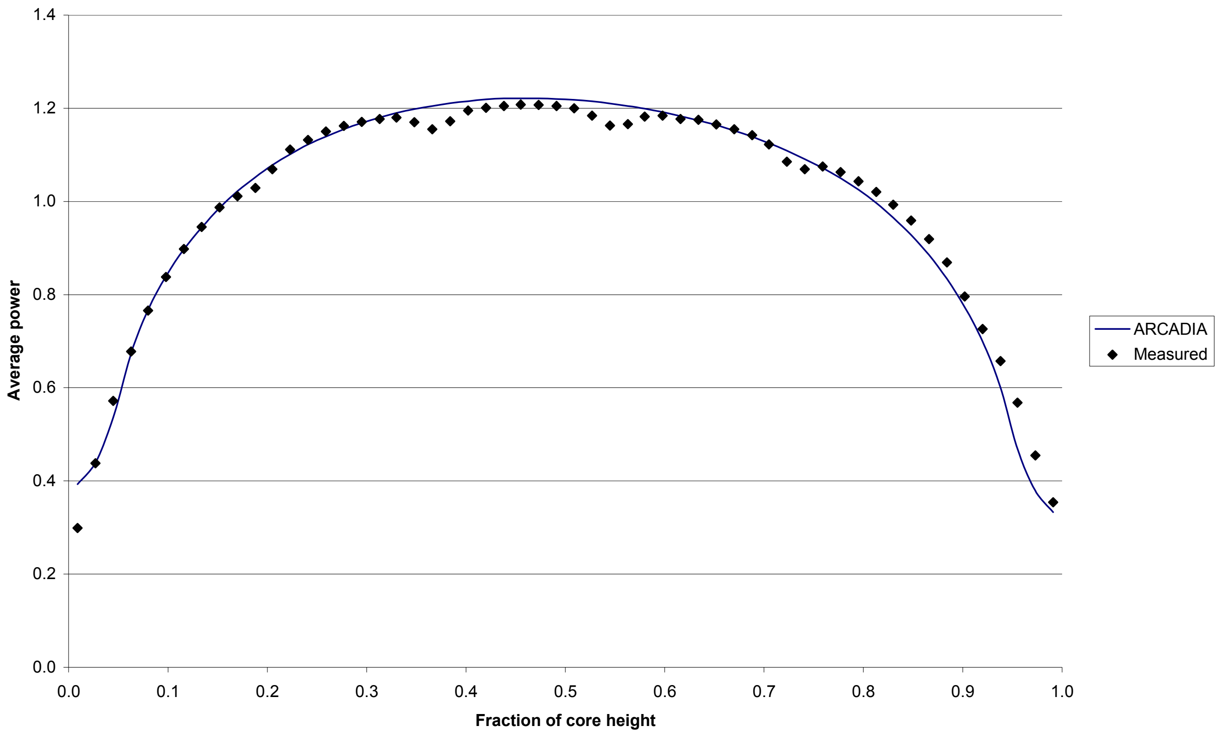
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.1

Figure V1 10.4.9-32: Plant V1 EOC 21 Core Average Axial Power Distribution



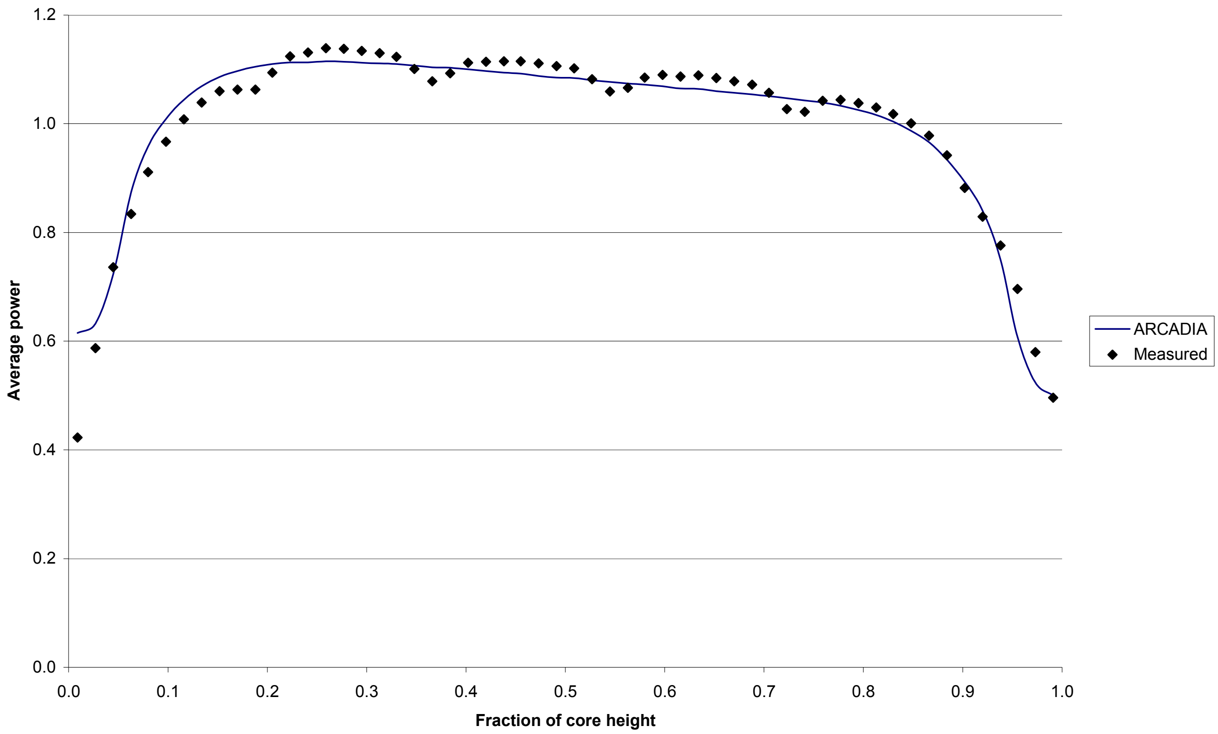
Calculated minus Measured Average Core Axial Powers, RMS difference = 4.0

Figure V1 10.4.9-33: Plant V1 BOC 22 Core Average Axial Power Distribution



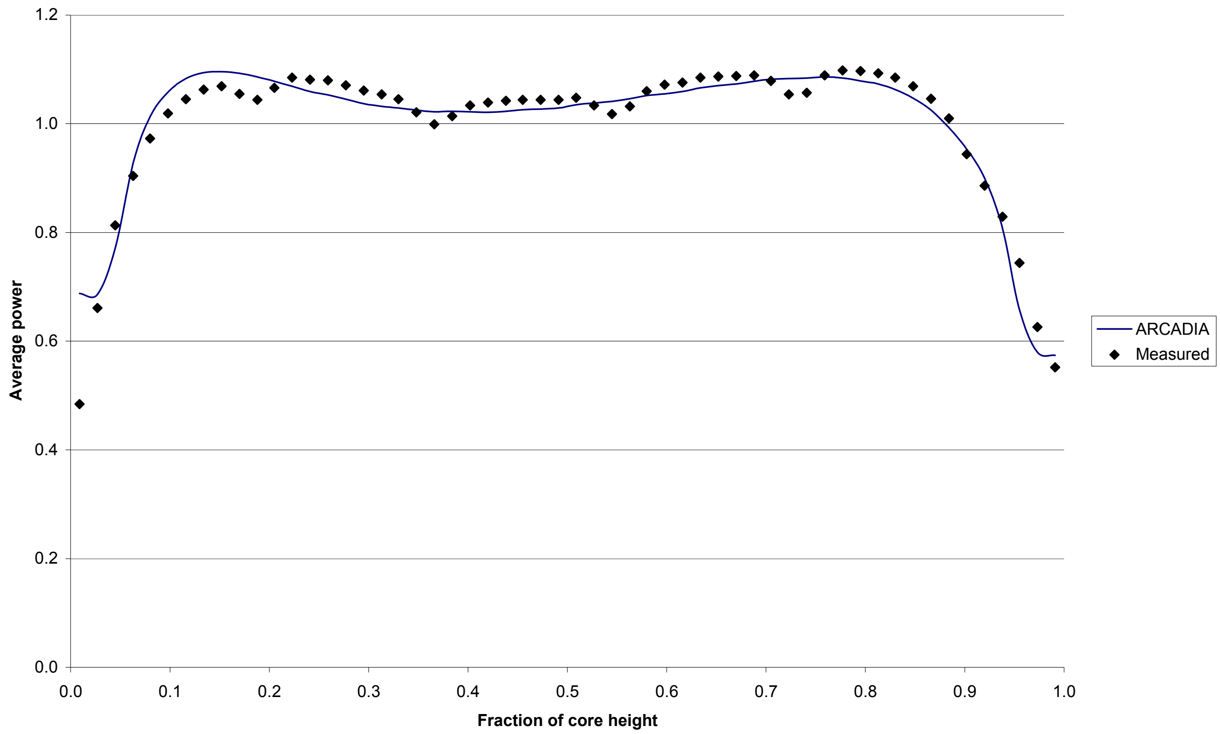
Calculated minus Measured Average Core Axial Powers, RMS difference = 3.0

Figure V1 10.4.9-34: Plant V1 MOC 22 Core Average Axial Power Distribution



Calculated minus Measured Average Core Axial Powers, RMS difference = 3.6

Figure V1 10.4.9-35: Plant V1 EOC 22 Core Average Axial Power Distribution



Calculated minus Measured Average Core Axial Powers, RMS difference = 3.7