

Nuclear Integrated Services (NIS)

Nuclear Thermal Engineering Services

Background

Nuclear Integrated Services (NIS) has extensive experience solving technical, licensing and operational issues for operating nuclear plants, including providing nuclear thermal engineering services.

Description

The NIS thermal engineering team is a technical specialty group that focuses on plant thermal analyses, thermal equipment design, evaluation and specification, fluid system analyses and engineering economics. The engineers in this group average more than 20 years of experience in all phases of plant design, system engineering, performance analyses, engineering economics and cycle optimization. NIS has prepared analyses that range from preliminary cycle models (similar to a turbine thermal kit) to complete final heat balances that account for the as-built equipment performance, fluid friction loss in piping systems and site climatic conditions.

Benefits

NIS has performed a number of specific activities and responsibilities as described below.

- **Heat Balances.** We perform heat balance modeling, which can be used in the following areas:
 - Conventional steam power cycles for new plants
 - Uprate performance modeling
 - Plant performance auditing, troubleshooting and improvement
 - Advanced power cycles

Currently, our main focus is the performance of heat balance model tuning and uprate performance predictions. Our specialists obtain plant operating data for all major power cycle operating parameters and scrutinize the data for plausibility and consistency. Frequently working with Performance Evaluation of Power System Efficiencies (PEPSE) models, the models are tuned based on valid plant operating data to create benchmark heat balances at pre-uprate thermal power conditions, and used to reconcile differences between with turbine supplier performance predictions. Using these tools, our specialists also perform economic trade-off studies for various equipment upgrade options and establish input data for use by steam turbine suppliers in designing replacement steam paths.

- **Performance Recovery and Enhancement.** The NIS experts conduct plant performance audits to identify and accurately quantify causes of output losses and other forms of degradation. By virtue of our extensive familiarity with the best design and optimization practices in many of the U.S. operating nuclear plants, we can provide valuable guidance to enhance any plant's performance. The NIS team also works in concert with complementary Westinghouse organizations to provide tools (e.g., EnergiTools™) and expertise to support the plant's Thermal Performance Monitoring Programs.
- **Heat Rejection Optimization and Environmental Compliance.** The NIS specialists perform a full range of services to assist clients in their compliance with Clean Water Act Sections 316(a) and 316(b) regulations. These services include design of compliant intake structures as well as technical and economic evaluations of cooling tower retrofits. We also provide valuable expertise in the planning of maintenance or modification activities and/or the expansion of existing closed-loop cooling systems. These projects span the full range of natural draft, mechanical draft and hybrid cooling towers, cooling ponds,

and once-through systems with helper towers. The NIS team is also active in the optimization of heat rejection system operation, considering seasonal control of cooling water pumps and cooling tower fans, to minimize annual evaporation losses.

- **Performance Testing.** The NIS experts prepare/ review performance test procedures for the overall plant and for individual power cycle components, including turbines, condensers, moisture separator reheaters (MSRs), feedwater heaters and cooling towers. Our specialists witness the testing and can prepare and/or review of performance test reports.
- **Thermal-hydraulics.** The NIS team of specialists is an industry leader in the design and analysis of flashing and critical flow piping systems and gravity flow piping with saturated liquid. Such techniques are especially important for heater drain and relief valve systems. The thermal engineering team is performing much of the fluid systems analysis work for the Westinghouse AP1000® nuclear power projects.
- **Thermal Equipment.** Thermal cycle (including heat rejection system) optimization is important in today's competitive electric power marketplace and is often the key to the success of a project. The typical optimization efforts include minimizing the unit heat rate, while maintaining a sensitivity to the site-specific environmental requirements, the proper specification of major components, and developing economic designs that lower the life-cycle costs. Some of the thermal equipment our engineers optimize, specify, and select includes feedwater heaters, condensers, MSRs, cooling towers, de-aerators and miscellaneous heat exchangers.
- **Rotating Equipment.** The NIS team offers extensive expertise in the specification, design, selection and plant integration of equipment such as steam turbines and replacement steam paths, major power cycle pumps and their turbine drives, as applicable, and circulating water pumps.
- **Hydraulics.** The NIS team models compressible and incompressible fluid systems. We have extensive experience with steady state, transient and water-hammer analyses using commercial software tools such as ProtoFlo® and AFT Arrow™, Fathom™ and Impulse™, as well as several proprietary NIS programs.

- **Advanced Technologies.** NIS is active in the power cycle design for new power generation technologies such as the Pebble Bed Modular Reactor (high-temperature, helium-cooled), small modular reactor concepts and supercritical CO2 power cycles.

Experience

NIS has provided thermal engineering services for over 20 uprate projects.



A replacement turbine rotor increases plant electrical output.



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