

# WESTEMS™ Integrated Diagnostics and Monitoring Systems

## Background

WESTEMS™ is designed as a dual-use technology for both American Society of Mechanical Engineers (ASME) design analysis and online fatigue monitoring purposes. Every model built in a WESTEMS design analysis project can be put into service in a monitoring role, and either Westinghouse or the utility engineer can add new models to a project at any time. This technology resulted from an effort to reduce the overall life-cycle engineering costs of Westinghouse-supplied equipment and services. This means that all Westinghouse Design Services that use WESTEMS models to perform the ASME design fatigue analyses can be used for online monitoring purposes for little additional cost. The models can calculate and track transients and fatigue usage factors automatically. Installation of the WESTEMS program and project models at a plant site simply requires a dedicated computer/server and a plant computer data historian interface to acquire plant data from existing sensors. The process that feeds plant data can be manual or automatic, depending on the plant information infrastructure.

## Description

WESTEMS is a Microsoft® Windows®-based integrated diagnostics and monitoring system. It is modular in design, using project-based models and a family of plug-in programmable components. Westinghouse engineers use the system to perform ASME design stress and fatigue analyses using NB-3200 criteria. Projects developed in WESTEMS use integrated models that contain plant thermal-hydraulic models, mechanical interaction models, local stress models and Green's functions, and supporting utilities. The integrated models can be used in ASME design evaluations or in online monitoring roles.

The power and versatility of the WESTEMS integrated system are demonstrated in the following major program features:

- Flexible data acquisition
- Effective data checking and correction
- Component stress and fatigue monitoring
- Automatic transient cycle counting
- User-configurable integrated modeling
- User-programmable graphical user interface (GUI)
- Easy access to system database information

The physical system requires a dedicated data acquisition computer/server (machine may be physical or virtual). This data acquisition machine also may be configured as an analysis workstation or, alternatively, multiple supporting analysis workstations may be configured (workstations may be physical or virtual). WESTEMS uses a user-programmable GUI that can be customized for each project. The responsible engineer can perform management and configuration activities using the GUI program. The modeling databases WESTEMS uses are compatible and open for use by other software utilities, enabling the information they contain to be shared.

WESTEMS attains a significant computational advantage over traditional stress analysis methods through the use of integrated models, technologies like the transfer function method, and advanced data management and analysis techniques. Integrated models also can be used repeatedly for offline evaluation of potential plant transient scenarios at significantly reduced cost. Significant cost reductions are obtained when analyzing new transients or considering actual plant transients during a re-qualification. Fully developed models can be used simultaneously by multiple users for independent tasks like design basis or environmentally assisted fatigue analysis, fracture mechanics qualifications, and online transient and fatigue monitoring.

In the online monitoring role, WESTEMS also provides surveillance activities like Technical Specification cycle counting, thermal stratification monitoring and unanticipated event qualification. These features help achieve superior levels of surveillance and awareness concerning the structural integrity of the primary system, related systems and components. The total WESTEMS program provides exceptional coverage over a broad range of structural integrity issues pertaining to pressurized water reactor operations and components.

WESTEMS integrates a number of surveillance functions and related engineering tasks into one program:

- Design basis transient cycle counting
- Heatup and cooldown rate limits surveillance
- ASME structural integrity screening evaluations of unanticipated events
- Thermal stratification monitoring
- Stress and fatigue monitoring

## Benefits

WESTEMS diagnostics and monitoring technology achieves integration goals that link design and online models and documentation. It also provides a user-ready tool to create and integrate new models as required for surveillance of plant component fatigue.

WESTEMS integrated models performing continuous surveillance service provide more than just paper reports that satisfy component qualification requirements. They also provide:

- Automated satisfaction of administrative surveillance requirements and commitments as part of the plant fatigue aging management program
- Severity-based transient characterization and cycle counting
- Fatigue usage factor monitoring
- Diagnostic trending and projection of results
- Improved operational awareness
- Reduced equipment life-cycle engineering costs

WESTEMS software employs two types of stress-based fatigue monitoring models, using either simplified closed-form stress solutions, or detailed Green's function stress models with six-component stress tensors.

The WESTEMS monitoring system is flexible and user-configurable, such that the user can edit existing diagnostic models or add new models without the need to re-compile the software.

## Experience

Westinghouse has provided the WESTEMS system to 18 nuclear power plants.

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