



# POWER GENERATION: UPRATE AND RETROFIT SERVICES

## OVERVIEW

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Retrofits and power uprates can be economical solutions to improve performance and electrical output; however, there are many technical challenges which must be managed to ensure a successful turbine and generator design, manufacturing process, and installation. ENTRUST is unique in that we have over 15 former turbine and generator OEM engineers on staff – covering design, manufacturing, and field engineering. The ENTRUST team is supplemented by former Utility engineers, who have successfully managed similar uprate and retrofit projects, as well as our operations, analytical and training staff.

## RETROFIT AND UPRATE SERVICES

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### SPECIFICATION DEVELOPMENT AND PROPOSAL REVIEW

ENTRUST has the OEM, utility, and consulting experience to develop robust specifications which includes lessons learned and best practices from dozens of similar retrofit and uprate projects. Proposals can also be reviewed for technical merit and offerings.

### THIRD PARTY OEM DESIGN REVIEWS

ENTRUST routinely provides structured engineering design reviews of new and retrofit units. This allows for detailed vetting of long-term reliability and performance of proposed designs at a time when changes can still be incorporated. This process typically leads to multiple design enhancements.

### MANUFACTURING-SHOP SURVEILLANCE

ENTRUST has a large staff of former OEM engineers who can help oversee the quality of the manufacturing process. This starts with support negotiating witness points with the OEM and can include in process checks from initial forging inspections at sub-suppliers through final acceptance testing of the purchased hardware.

### THERMAL PERFORMANCE AND GUARANTEE ASSESSMENT

ENTRUST has decades of experience in power plant performance testing and guarantee conditions. This typically includes review of performance acceptance test procedures, correction curves, 3rd party evaluation of acceptance test data and performance improvement recommendations.



## SAMPLE SERVICES (CONT.)

### TORSIONAL VIBRATION ANALYSIS AND TESTING

System torsional frequencies are impacted by changing of the turbine(s) and/or generator. ENTRUST can complete independent torsional frequency modeling and torsional testing if analysis frequencies are inside the ISO avoidance zones.

### NON-CONFORMANCE REVIEW AND DISPOSITIONS

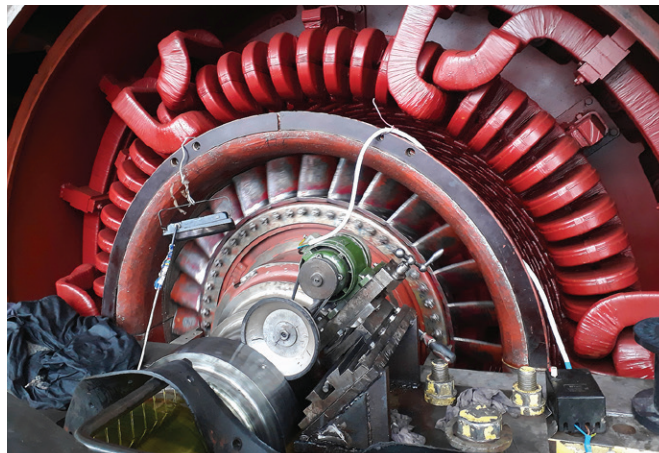
All projects of the magnitude of a retrofit/upgrade will have manufacturing non-conformances. ENTRUST can quickly inform you on the risks and recommended path forward. When needed, ENTRUST can provide OEM level FEA and engineering analysis work to assess risk levels of observed conditions.

### OUTAGE PLANNING

ENTRUST has the experience planning major maintenance, including timing, budgets, and contingency items. Outage planning support can include preoutage unit condition assessment, service bulletin review, bid specification development, participation in pre-outage meetings, and shop/vendor vetting.

### TURBINE AND GENERATOR INSURANCE RISK REVIEW

Retrofit designs often include new technologies which can introduce additional risks or uncertainty, which ultimately can impact insurance premiums. ENTRUST can provide a review of the design and technical considerations, as well as mitigating strategies to help manage insurance risks.



### RETAINED AND INTERFACE EQUIPMENT IMPACT STUDIES

ENTRUST has the OEM, utility, and consulting experience to assess retained equipment to ensure compatibility, and the condition supports continued use.

### INSTALLATION – PROJECT MANAGEMENT AND OWNERS REPRESENTATIVE

ENTRUST has experience providing on-site retrofit installation oversight and commissioning service, both from a field engineering and project management standpoint.

### OPERATOR TRAINING

ENTRUST offers both engineering and operator/maintenance technician training customized to your site and powerplant equipment

### NERC

ENTRUST provides a complete set of testing and modeling services for generator control and projection systems and the required documentation to satisfy NERC compliance requirements for MOD-025, MOD-026, MOD-027, PRC-019, PRC-024, PRC-025, PRC-026, PRC-027, VAR-501-WECC, and other regional/ISO specific requirements.

## SAMPLE SERVICES (CONT.)

### EXCITATION CONTROLS SUPPORT

ENTRUST can provide a review of the excitation system ratings, auto-voltage regulator tuning, limiter/protection settings, and power system stabilizer tuning in support of an uprate. This includes decades of experience associated with excitation control retrofits, commissioning, and tuning of nearly all OEMs and prime mover types.

ENTRUST also offers outage based in-the-loop testing of excitation and power system stabilizer controls to ensure proper dynamic performance of the closed-loop controls at new higher power levels prior to bringing the unit online. This includes both site and factory acceptance testing support.

### GENERATOR REACTIVE CAPABILITY STUDIES

ENTRUST performs analysis to determine the reactive power capability range of the generator based on the generator and step-up transformer ratings, transformer tap settings, and system voltage conditions. This information is often required by system operators in association with an uprate.

### MODELING AND SIMULATION STUDIES

ENTRUST offers modeling and simulation study services associated with uprates and retrofits. This includes control system tuning and dynamic response studies and providing preliminary models for submission to the system operator for approval.

