Increasing the Safety and Reliability of Nuclear Power Generation
Invensys Nuclear

Your single source for Instrumentation & Control (I&C) solutions. Our proven engineering record, nuclear industry certifications and project methodologies ensure the highest reliability solutions in the industry.

Invensys’ innovations are your path to the digital plant of the future

Invensys is a leading global provider of industrial automation hardware, software, engineering and consulting to all types of industrial facilities, but particularly the nuclear industry. Our nuclear industry practice – Invensys Nuclear – leverages high-reliability, certified technologies and deep knowledge of the control of nuclear processes and support systems, offering:

- **Domain Expertise** - Over 80% of nuclear power generation plants in the United States use Invensys technologies and services
- **A World-class Solution Portfolio** - from instrumentation and measurement to fleet-wide operations
- **U.S. NRC approval** - The Triconex Triple Module Redundant (TMR) controller has 1E safety-related approval by the U.S. Nuclear Regulatory Commission (NRC)

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Invensys received a new SER for TRICON Version 10 in 2012. This ensures the lowest possible risk platform for safety-related digital upgrades, including compliance with ISG-06, the latest regulatory guidelines. The 2012 SER demonstrates Invensys’ sustainability and long-term manufacturing capabilities. By combining TRICON V10 with the new, nuclear-specific products found in this brochure, a significant step forward can be made in the migration to all-digital control, as well as easing the licensing process and mitigating obsolescence risk. For more information, please reference ADAMS Accession No.: ML120900889.
Invensys Nuclear Technology to Sustain Every Aspect of Nuclear Power Generation

Foxboro / Eurotherm Measurement & Instrumentation
A broad range of measurement and instrumentation products from Foxboro® and recorders and controllers from Eurotherm®.

Foxboro I/A Series System Distributed Control System
The backbone of the Distributed Control System (DCS), Balance of Plant, and Data Historian is Foxboro I/A Series®, a DCS offering optimal performance for operators, engineers and maintenance. I/A is engineered for non-stop operation with fault-tolerance capability at all levels of the system, from process controllers to redundant field networks and Fieldbus modules. Fiber optic cabling virtually eliminates system noise and grounding problems.

Triconex Safety-Related (1E) Control & Safety
Triconex is the world’s leading safety and critical control system. The Triconex Tricon system is fault tolerant and based on a TMR architecture. It has also been qualified by the U.S. NRC for use in safety-related (1E) applications since 2001. Typical applications include controls for:

- Turbomachinery
- Feedwater systems
- Emergency generators
- 1E chillers
- 1E ventilation
- 1E QSPDS
- Auxiliary feed pumps
- RPS and ESFAS systems

SimSci-Esscor Process Simulation and Training
SimSci-Esscor™ independent simulation software:
- Improves operator effectiveness in responding to different scenarios
- Improves plant performance
Avantis Asset Management
Avantis® asset management software monitors equipment, maintains equipment history and specifications, and supports predictive maintenance and replacement protocols to minimize unexpected downtime and extend the life of plant assets.

Wonderware InTouch Process Visualization – Plant Computer
Wonderware® InTouch® software provides a simple and easily configurable Human Machine Interface (HMI) capability with standalone systems or local HMI interfaces needed to visualize process and operational data.

Wonderware IntelaTrac Mobile Workforce Management
Wonderware IntelaTrac® mobile workforce management brings intelligent workflow, automated asset tracking and data collection to field operations and maintenance. Staff efficiency increases as information is conveniently made available when and where it is required.

InFusion Enterprise Control System
The InFusion™ Enterprise Control System integrates all aspects of operations, spanning distributed control, safety, decision support, asset management, and process visibility. As an integration framework, InFusion enables communication between operational and enterprise financial systems, improving visibility and designion-making across the site and business.
Delivering Value Through Lifecycle Services

Providing the plant owner/operator with a single point of commercial responsibility, the dedicated Invensys Nuclear Group provides a single source for plant automation systems, from upgrades and retrofits to new construction. Applying deep nuclear industry domain expertise and international experience, our solutions comply with 10 CFR Part 50 Appendix B and 10 CFR Part 21, NQA-1, and IEEE 1012. Some of our typical projects include:

New Plant Construction
Invensys provides the complete lifecycle of engineering services to support the planning, design and construction of plant instrumentation and control systems, from initial feasibility and Front End Engineering Design (FEED) studies through factory-acceptance testing and commissioning. Having Invensys Nuclear as a single point of commercial responsibility for I&C systems reduces project risk while ensuring that plant systems are effectively integrated.

Control System Expansions and Upgrades
Instrumentation and control systems at many nuclear facilities are experiencing obsolescence, which means greater difficulty in acquiring spare parts and rising support costs. Upgrading aging control systems can reduce lifecycle costs, improve reliability, and increase safety margins.

Control Room Design
Leveraging the advanced Foxboro I/A Series DCS, Triconex 1E safety-related controllers, and advanced software applications, the Invensys Nuclear Group designs highly efficient, ergonomically effective nuclear control rooms that improve plant operations and safety.

Instrumentation and Control Architectures
The Foxboro line of control and I/O devices provide seamless integration of Fieldbus capabilities, including Fieldbus Foundation, Fieldbus Foundation Control in the Field, HART, PROFIBUS, Modbus, and our own FoxCom, among others. Invensys is also a leading contributor to the emerging Field Device Tool (FDT) technology and is proud to be a founding member of the FDT Joint Interest Group. Working closely with your engineering team, we can develop an appropriate instrumentation and control architecture that increases safety, security and operational performance.

Cyber Security Inspections and Implementations
Some of the most stringent cyber security requirements pertain to the nuclear industry. The Invensys Critical Infrastructure and Security Practice (CISP) applies a comprehensive cyber security portfolio which takes a ‘360 degree’ approach to securing the information technology infrastructure. The CISP methodology is applicable to any process safety control system, delivering a solution that meets or exceeds NRC and NEI regulations and guidelines.
Providing Thought Leadership in Nuclear I&C Solutions

**Turbine Control System Upgrades**
Upgrading existing turbine controls and implementing new systems are principal components of our business. Invensys solutions include comprehensive turbomachinery controls that help achieve measurable performance improvements. Invensys offers solutions and value-added services to protect turbomachinery assets and enhance their productivity, safety and effective life.

**Feedwater Control Systems**
Replacing aging feedwater control systems with digital solutions from Invensys reduces lifecycle costs and increases safety margins. Nuisance system trips are also avoided, reducing plant outages. Invensys Solutions are easy to operate and maintain, offering an expandable platform that can grow with feedwater system requirements.

**Software Application Engineering**
Our Intelligent Engineering approach to software application development is proven to manage project risk and schedule. From small projects to large, Invensys applies consistent rigor, management and engineering to protect your software investment and deliver results. Security, safety and reliability are paramount in nuclear plant operations. Our software development methodology includes multiple quality-control stage gates, ensuring the reliability and efficacy of software applications.

**Integration with OEM and Third-Party Systems**
Since Invensys provides a single point of commercial and technical responsibility as the I&C Solutions provider, we can ensure the effective, reliable, and secure integration among OEM and third-party systems and applications. Leveraging tools like the Invensys InFusion platform for Enterprise Control, as well as industry standard communication protocols, our integrated plant-wide and enterprise-wide solutions enable the alignment of roles across the nuclear business: environment and safety, people, assets, control systems. Working together, this integrated environment can empower your most important asset – people.
Delivery of projects on time and within budget demands vetted procedures implemented by an engineering staff with a culture of procedural compliance and safety consistent with that of the nuclear industry. Invensys has both the culture and the continuous improvement practices to meet your requirements today while helping you to address future challenges. Invensys is your single source supplier, offering integrated, secure, and certified digital I&C solutions.

Invensys Nuclear develops and delivers fully integrated solutions for our nuclear customers under its Project Integration and Delivery organization. Invensys Nuclear solutions incorporate Invensys and third-party products and services for a fully operational, integrated solution in accordance with customer-specified requirements.

**Delivering Value Throughout the Project Lifecycle**

From kick-off to commissioning, training, and on-going support, Invensys consultants work closely with your engineers and operators to ensure that they receive the necessary knowledge and skills to effectively and efficiently take full advantage of the solution.

The Invensys Nuclear System Integration Program Manual governs all quality-affecting project activities performed by personnel within the Invensys Nuclear Group. It also implements the requirements of the Invensys Nuclear Quality Assurance Manual, 10 CFR Part 50 Appendix B, NQA-1, and applicable Regulatory Guides and Standards. Specific standards associated with software activities include, but are not limited to Regulatory Guide 1.168 and IEEE Standards 830 and 1012.
Invensys Service and Support Options

The Invensys Customer FIRST service and support program provides our clients with the opportunity to extend the value of our products and solutions. The four tiers of the program are Elite, Premium, Standard and Primary and allow for flexibility when choosing which level of service is most appropriate. Each tier comes with varying levels of hardware and software support, as well as support for parts replacements, version upgrades and technical support.

Invensys also offers service and support for application support, on-site resources and value-added consulting. Supplementary Flexible Credits can also be added for specialized services, hardware materials and training.

Customer FIRST – Sustained Value to Nuclear Operations

- Protect critical investments with experienced, skilled Invensys teams
- Maintain your hardware and software and respond to any needs in a timely manner
- Maximize asset performance by reducing downtime and maximizing performance levels
- Reduce Total Cost of Ownership (TCO) through high reliability solutions and flexible funding options
- Improve operational performance by driving added value and discover new ways to improve performance
- Deliver consistent and reliable support that allows for effective planning, budgeting and control
Our Quality Management System and Nuclear Industry Certifications

Our Quality Management System (QMS) is structured to deliver the highest-quality reliability and most efficient services, enabling Invensys Nuclear to:

- Continually provide consistent, reliable and dependable products, services and solutions
- Increase the reliability and efficiency of nuclear power generation processes
- Engineer and manufacture cost-effective products with the lowest life-cycle costs
- Ensure on-time delivery based on a Lean Six Sigma methodology throughout the nuclear business

The Invensys Nuclear Quality Assurance program has been developed and implemented to comply with regulatory, industry and client quality requirements for products and services provided to the global nuclear industry. The Invensys Nuclear Quality Assurance Manual prescribes the practices and procedures that have been established and maintained by each Invensys delivery facility involved in the design, manufacture and service of our nuclear products. The following documents constitute the basis for the Invensys Nuclear Quality Assurance program:

- 10 CFR Part 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
- ASME NQA-1-1994, Quality Assurance Basic Requirements for Nuclear Facility Applications
- 10 CFR Part 21, Reporting of Defects and Non-Compliance
- IAEA 50-C-QA, Code on the Safety of Nuclear Power Plants: Quality Assurance
- CSA N286-05, Management System Requirements for Nuclear Power Plants
- HAF003, Quality Assurance of Nuclear Power Plants
- KTA 1401, General Requirements Regarding Quality Assurance
- KEPIC-QAP, Nuclear Quality Assurance

The Invensys project procedures and practices represented by the Nuclear System Integration Program Manual have been audited and deemed to be satisfactory by several outside organizations including various nuclear customers, Nuclear Procurement Issues Committee (NUPIC), and the Quality & Vendor Branch of the NRC Office of New Reactors (See Inspection Report identified as ADAMS Accession # ML082460540).

All application software developed by Invensys Nuclear is based on a software life cycle that is modeled from NQA-1. Planning for software development and V&V activities are detailed in the project plan, project quality plan, Software Quality Assurance Plan (SQAP), and Software Verification and Validation Plan (SVVP). Application software developed by the Project group is then subject to review by V&V based on the customer’s project requirements. Graded approaches can be applied from peer review to full independent V&V of the software by our IV&V group.

“A digital upgrade with a Tricon-based architecture integrated with customized sensors developed by Foxboro technology/RTDs, transmitters and Wonderware Human Machine Interface (HMI) with real-time data trending capabilities enhances system operability and maintainability.”

—Francis Liu, Southern California Edison
Customer-focused Business Results

**Duke Power** – Duke Power operates three nuclear stations and has provided safe, reliable, and economically priced power to the Carolinas for a century. Oconee, Duke’s Nuclear Station in South Carolina, has a capacity of 2,538 megawatts and serves more than two million customers throughout a 22,000 square-mile service. Since its inception, Oconee has generated more than 495 billion kilowatt hours of electricity - more than any other nuclear station in the United States. In 2000, Oconee earned further distinction as the second nuclear station in the country to have its licenses renewed by the Nuclear Regulatory Commission for an additional 20 years.

Invensys enabled the plant’s existing diagnostic software to pinpoint, locate and guide troubleshooting as well as to upgrade a hard-panel interface. The project resulted in greater plant reliability and capacity factor, while balancing the region’s growing electricity needs with care for the environment.

**PPL Susquehanna, LLC** – PPL Susquehanna Steam Electric Station is a Boiler Water Reactor (BWR) nuclear power generation plant with two main turbines that each produce around 1,200 megawatts of power. Invensys was tasked with the control system upgrade and modernization of both units, including the two main turbines and all six feed-water turbines.

**Taiwan Power Corporation (TPC)** – TPC owns and operates many power generating plants throughout Taiwan and recently awarded Invensys the contract to upgrade the Maanshan Unit 3 Nuclear Station that consists of two large GE reheat turbines, each driving its own generator and producing close to 1,000 megawatts. The two main turbines are supported by six smaller feedwater pump turbines. The plant was built in the seventies, and like other older nuclear plants, required modernization on its turbine controls, including an upgrade to hydraulic overspeed protection and digital controls.

“Not having to rely on an outside vendor is a big benefit. We have more control to modify the logic design of the system to match the needs of our plant. With the digital control system, we can easily make enhancements.”

—Marlon Dempsey, I&C Engineer, Duke Power