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**Reference: Customer Advisory - 02**

**Re: Instrumentation and Control Mechanical Integrity Programs**

To Our Customers:

There has recently been a great deal of interest in the mechanical integrity programs that are being employed at process plants. Specifically, there has been a good deal of interest in instrumentation and control systems that are critical to safety. The widespread adoption of ISA 84.01 in the process industries has been seen as a great benefit in terms of increased safety and also in terms of systematically identifying areas of concern and defining maintenance and testing practices required to achieve tolerable risk goals. The implementation of ISA 84.01 has also demonstrated the lack of similar systems and methods for other instrumentation and control systems used in plants that have safety ramifications.

Plant management and regulators have become concerned about the lack of mechanical integrity programs for instrumentation and control in some plants, and the lack of a sound basis for testing and maintenance programs in others. In addition, site-to-site variability in programs of the same company has also become a great concern. In order to rectify this situation many organizations are undergoing projects whose purpose is to improve their mechanical integrity programs and make them more consistent from site to site. These projects typically include classifying instruments based on their purposes, and then potentially their criticality, and then developing a basis for testing and maintenance programs that is a function of their type and criticality.

**Mechanical Integrity Programs**

At the highest level, a mechanical integrity program for any refinery in the United States should be in conformance with the Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.119 and the Environmental Protection Agency (EPA) Regulation 40 CFR Part 68. These regulations set requirements for mechanical integrity programs. These standards apply to a number of equipment items, including:

*"(iv) Emergency Shutdown Systems*

*(v) Controls (including monitoring devices and sensors, alarms, and interlocks)"*

Further, these regulations require that programs be developed and implemented for the above systems that include the following provisions:

*"(2) Written Procedures*

*(3) Training for Process Maintenance Activities*

*(4) Inspection and Testing*

*(5) Equipment Deficiencies*

*(6) Quality Assurance"*

The OSHA and EPA regulations noted above are performance based, allowing the owner/operator of the facility a great degree of latitude to implement a program that is most suitable for the organization and site, as long as it meets the general requirements listed in the standard. Industry has been very supportive of the goals promulgated in these standards, and has supported their implementation by providing standards, recommended practices and technical reports that provide guidelines for how these regulations. This additional guidance is published by industry groups for areas where their membership has particular expertise. Some of the organizations that have published guidance that is relevant to this project include:

1. American Petroleum Institute (API)
2. National Fire Protection Association (NFPA)
3. Instrumentation, Systems, and Automation Society (ISA)
4. International Electrotechnical Commissions (IEC)
5. Engineering Equipment and Materials Users Association (EEMUA)
6. Abnormal Situation Management Consortium (ASM)
7. American Institute of Chemical Engineers (AIChE)

While the program that an owner/operator implements at a specific site is not required to be identical to the standards, recommended practices, and technical reports provided by these bodies, they provide an excellent benchmark for the practices of industry. If a site's programs are not in conformance with these guidelines there should be solid explanation of why the industry guidance is inappropriate and why the site's alternative is superior.

A site's instrumentation and control mechanical integrity program should consider the following provisions and standards and guidance for their implementation.

1. Classification of Instrumentation and Control

All instrumentation and control equipment should be classified. The EPA/OSHA regulations and many of the industry standards are performance-based, allowing maintenance and testing resources to be disproportionately spent in areas where the need is greatest. In addition, different standards are applied to different kinds of instrumentation. A good classification process is a necessary first step in implementation of a mechanical integrity program. An appropriate industry standard that can be used as a guideline for this task is *ISA 91.01 – Identification of Emergency Shutdown Systems and Controls that are Critical to Maintaining Safety in Process Industries*.

## 2. Identify Programs for Each Instrumentation and Control Category

The entire body of instrumentation and control equipment can be subdivided (by review of every instrument shown on every P&ID in the facility) into categories. The categories are at the discretion of the site to some degree, but typically include the following.

- Regulatory Controls (Those which are not protective, i.e. every instrument category that is not listed in any other item below)
- Safety Instrumented Systems
- Alarm Systems
- Fire and Gas Systems
- Burner Management Systems
- Compressor / Turbine Monitoring Systems
- Simple Manually Activated Protective Functions (e.g., remote isolation valves)
- Complex Manually Activated Protective Functions (e.g., HF Alky Water Curtains/Cannons)

For each type of system, a mechanical integrity program should be in place, which will be reviewed that includes provisions for the frequency of inspection and testing, and procedures by which those inspection and testing tasks are performed. These programs should consider both recommendations of the vendor and criticality of the instrument. The program should also describe methods by which proper equipment selected and installation is ensured.

## 3. Regulatory Controls

A program for mechanical integrity of regulatory controls is generally considered less critical than the program for protective functions, and is typically performed based on recommendations from equipment vendors and industry peer practices.

#### 4. Safety Instrumented Systems

Programs for safety instrumented systems are generally performed in accordance with the *ISA 84.01– Application of Safety Instrumented Systems for Process Industries*. This standard requires that all safety instrumented functions be classified using a safety integrity level (SIL) of 1, 2, or 3 and that the equipment selection and test plan be developed in concert with a quantitative reliability assessment showing that the probability of failure of demand estimated for the system is in accordance with the SIL that was selected.

#### 5. Alarm Systems

Alarm system programs can be developed in accordance with *EEMUA 191 – Alarm Systems – A Guide to Design, Management, and Procurement* as a best practice. This guideline recommends that alarms be rationalized and prioritized to ensure that the amount of alarms and their display is appropriate for operations staff. Equipment selection and testing and maintenance program is typically tied to the priority that has been assigned to the alarm. Unlike safety instrumented systems, the alarm system standards have not predefined alarm priorities, which are assigned at the discretion of each site and is typically a function of the type of DCS hardware used at the facility. The programs for alarm systems are typically based on judgment and the concept of an “independent protection layer” as defined in AICHE Guidelines from the AICHE’s Center for Chemical Process Safety (CCPS).

#### 6. Fire and Gas Systems

Fire and Gas Systems are typically designed in accordance with *NFPA 72 – National Fire Alarm Code*. This guideline provides prescriptive requirements for equipment selection, installation and connection processes, testing frequency and testing procedures.

#### 7. Burner Management Systems

Burner management systems (BMS) are a subset of safety instrumented systems. As such, consideration should be given to compliance with ISA 84.01. In addition, they should also comply with prescriptive requirements from other standards that are a function of the specific type of fired device upon which the BMS is installed. These standards will include *API 556 – Instrumentation and Control Systems for Fired Heaters and Steam Generators*, *NFPA 86 – Standard for Ovens and Furnaces*, and *NFPA 85 – Boiler and Combustion System Hazards Code*.

#### 8. Compressor / Turbine Monitoring Systems

Compressor and turbine monitoring systems are a subset of safety instrumented systems. As such, consideration should be given to compliance with ISA 84.01. In addition, they should also comply with prescriptive requirements from other standards that are a function of the specific type of compressor or turbine that they are monitoring. These standards will include *API 611 – General Purpose Steam Turbines for Petroleum, Petrochemical, and Natural Gas Industries*, *API 616 – Gas Turbines for the Petroleum, Chemical and Gas Industries*, *API 617 – Axial and Centrifugal Compressors and Expander/Compressors for the Petroleum, Chemical and Gas Industries*, and *API 618 – Reciprocating Compressors for the Petroleum, Chemical, and Gas Industries*.

## 9. Simple Manually Activated Protective Functions

Simple manually activated protective functions are typically designed in accordance with the prescriptive requirements that are often similar to the “emergency stop” provisions on the NFPA 79 standard. In addition, they can be designed to operate as an “independent protection layer” in conformance with AIChE guidelines.

## 10. Complex Manually Activated Functions

Some manually activated functions are so complex and situation specific that general industry guidance is either unavailable or unacceptable. In these cases special extra care should be taken in their design. In general the concept of an “independent protection layer” should be applied to the design of these systems. In addition, the design and testing interval should be selected based on more advanced techniques, potentially quantitative risk/reliability assessment.

## **Our Team is here to Help**

We provide our customers with a full complement of safety solutions to ensure regulatory compliance and engineered safety. Our staff has consulted with a number of plants in the chemical, refining, and pharmaceutical industries to assist in the development and implementation of mechanical integrity programs for instrumentation and control systems. Our expertise provides you with a trusted resource to ensure that your instrumentation and control mechanical integrity programs are done properly and in an efficient manner.

For more information on instrumentation and control mechanical integrity programs or our other services, feel free to contact Ed Marszal at (614) 451-7031 ext. 1, or [edward.marszal@kenexis.com](mailto:edward.marszal@kenexis.com).

Keep Safe,

Edward M. Marszal  
President, Kenexis

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This customer advisory provides information of a general nature concerning some industry practices involving engineered safeguards. These should not be taken as typical, suggested, or recommended levels of protection. The application of engineered safeguards is highly dependent on process-specific and site-specific factors that have a great deal of influence on the actual degree of hazard control strategy. Neither Kenexis nor its corporate officers make any representations, warranties, or guarantees concerning the content of this document.