RECENT DEVELOPMENTS AND TECHNOLOGY IMPROVEMENTS IN API RISK-BASED INSPECTION PLANNING TECHNOLOGY

DÉVELOPPEMENTS RÉCENTS ET AMÉLIORATIONS TECHNIQUES DANS L'API " PLANIFICATION DES INSPECTIONS BASÉE SUR L'ANALYSES DES RISQUES"

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ABSTRACT

A Joint Industry Project for Risk-Based Inspection (RBI JIP) was initiated and managed by API within the refining and petrochemical industry in 1994. The work of this JIP resulted in two publications, API 580 *Risk-Based Inspection* and API 581 *Base Resource Document – Risk-Based Inspection*. The concept behind these publications was for API RP 580 to introduce the principles and present minimum general guidelines for RBI while API 581 provides quantitative RBI methods. The API RBI JIP has made major advancements since the publication of these two documents and is working on the second edition of API 581. The second edition will be published in a three volume set, *Part 1 – Inspection Planning Using API RBI Technology*, *Part 2 – Probability of Failure in API RBI*, and *Part 3 – Consequence Modeling in API RBI*. This paper provides an overview of this new three volume set, describes the advances made in risk-based inspection technology, provides an overview of a new consequence modeler designed to evaluate complex fluids, and explains a new approach that utilizes API 579-1/ASME FFS-1 Fitness-For-Service (FFS) models to determine the probability of failure component of risk. This new approach reinforces the complementary nature of FFS and RBI for asset management and ensures that standard models and assessment techniques are used. In addition, this paper will also describe the relationship between the API RBI JIP and RIMAP *Risk-Based Inspection and Maintenance Procedures for European Industry* and how these two organizations are working to achieve commonality in RBI approaches.

RÉSUMÉ

Un projet industriel multi-client (JIP) portant sur les inspections basées sur l'analyse des risques (RBI) ou criticité, a été initié et conduit par l'API au sein des industries du raffinage et des industries pétrochimiques en 1994. Les travaux de ce JIP ont conduit à deux publications, l'API RP 580 "Inspections basées sur l'Analyse des Risques" et la publication API 581 "Documents de Base - Inspections basées sur l'Analyse des Risques" -. Le but de ces documents était, pour l'API

RP 580, de présenter les grands principes et de donner un minimum de procédures générales utilisées en RBI, et, pour l'API 581, de fournir des méthodes précises et chiffrées. Depuis la publication de ces deux documents, l'API RBI JIP a effectué d'importants travaux et travaille actuellement à la mise au point de la deuxième édition de l'API 581. Cette deuxième édition comportera trois volumes; Volume 1 - Planification d'Inspections conformément aux RBI de l'API, Volume 2 - Probabilité de ruine et Volume 3 - Modélisation des conséquences. Cette communication présente une synthèse de ces trois volumes, décrit les avancées faites dans la technologie des inspections basées sur l'analyse des risques, donne une vue d'ensemble sur la nouvelle modélisation des conséquence mise au point pour évaluer les fluides complexes et présente une nouvelle approche qui utilise les modèles de l'API 579-1/ASME FFS-1 Aptitude au Service (FFS) pour déterminer la probabilité de ruine d'un composant. Cette nouvelle approche renforce la nature complémentaire du FFS et du RBI pour la gestion des équipements et assure que des modèles et des méthodes d'évaluation normalisées sont utilisés. Enfin, cette présentation décrira les liens entre l'API RBI JIP américain et le projet RIMAP, Inspection Basée sur l'Analyse des Risques et Procédures de Maintenance pour l'industrie européenne, et comment ces deux organisations travaillent pour assurer la cohérence de leurs approches en matière de RBI.

INTRODUCTION

The API Risk-Based Inspection (API RBI) methodology may be used to manage the overall risk of a plant by focusing inspection efforts on the process equipment with the highest risk. API RBI provides the basis for making informed decisions on inspection frequency, the extent of inspection, and the most suitable type of NDE. In most processing plants, a large percent of the total unit risk will be concentrated in a relatively small percent of the equipment items. These potential high-risk components may require greater attention, perhaps through a revised inspection plan. The cost of the increased inspection effort may sometimes be offset by reducing excessive inspection efforts in the areas identified as having lower risk.

API 580 [1] provides guidance on developing a risk-based inspection program for fixed equipment and piping in the hydrocarbon and chemical process industries. API 581 provides quantitative RBI methods to establish an inspection program. A complete re-write of API 581 [2] as an API Recommended Practice is currently being prepared to capture new technology that has been developed by the API JIP, to provide a logical step-by-step procedure that will enable practitioners to better understand the methodology, and to make the technology clear to facilitate an effective peer review. The title of the document is being changed to *API RBI Technology* to emphasize the fact that significant technology, including industry best practices, is required to effectively implement an RBI program. The second edition of API 581 is targeted for publication during 2007 and will present the API RBI methodology in a three part volume:

- Part 1 – Inspection Planning Using API RBI Technology
- Part 2 – Determination of Probability of Failure in an API RBI Assessment
- Part 3 – Consequence Analysis in an API RBI Assessment

The calculation of risk in API RBI involves the determination of a probability of failure combined with the consequence of failure. Failure in API RBI is defined as a loss of

containment from the pressure boundary resulting in leakage to the atmosphere or rupture of a pressurized component. As damage accumulates in a pressurized component during in-service operation the risk increases. At some point, a risk tolerance or risk target is exceeded and an inspection is recommended of sufficient effectiveness to better quantify the damage state of the component. The inspection action itself does not reduce the risk; however, it does reduce uncertainty thereby allowing better quantification of the damage present in the component.

In API RBI, a component is defined as any part that is designed and fabricated to a recognized code or standard. For example a pressure boundary may consist of multiple components (cylindrical shell sections, formed heads, nozzles, tank shell courses, tank bottom plate, etc.). Equipment is defined as an assemblage of components.

An overall event tree for the API RBI methodology is presented in Figure 1. This figure illustrates how the probability of loss of containment from in-service process equipment and the consequence analysis portions of API RBI fits within the overall RBI methodology. Probabilities of loss of containment are a function of the generic failure frequencies for particular components and the calculated damage state (damage factors) of the component being evaluated.