API Inspection Summit – *Downstream* Preliminary Program

Tuesday, January 8, 2013:

Engineering/Analysis Track:

Morning Session:

Summit Kick-Off and John Bolton – Former US Ambassador to the UN – Keynote Speaker "Threats to American Security: A Closer Look at the World's Trouble Spots and How They May Affect Our Energy Supply"

The Importance of MOC in Asset Integrity - Y. Al-Mowalad, Saudi Aramco
Not only can a well-managed asset integrity program help in identifying and reducing safety risks before they escalate, but focusing on asset integrity can also play a major role in both achieving operational excellence and extending the life of ageing assets. The incident investigation reports published by the US Chemical Safety Board indicate ineffective Management of Change (MOC) — a key process among the Asset Integrity processes — is one of the major contributing factors in many catastrophic incidents. MOC is a quality management process for managing the change that is not in-kind on the asset. The International Organization for Standardization (ISO) has established rigorous quality standards that include MOC concepts for companies that do business in the international marketplace. Therefore; companies have to install protocols — in their standards and procedures — for addressing the MOC scope and depth. These protocols are required by external guidelines and regulations for managing asset integrity. This paper exposes the MOC process part of the asset integrity program. It addresses the main aspects of the MOC process; i.e., definition, types, common shortfalls in MOC process and the MOC process key success factors. The paper also discusses the need for enforcing the MOC through incorporating it as a requirement in the engineering standards and procedures. In addition, the paper disseminates Saudi Aramco Yanbu' NGL Fractionation Department's efforts toward having the MOC as a procedural prerequisite for any not in-kind change over the existing asset. MOC — the center of the asset integrity program — could remain short-lived unless there are fundamental changes in values, ways of thinking and approaches. This paper seeks to overcome resistance to MOC, which is relatively a new concept in the process industry.

Methods to Improve Your Mechanical Integrity Program – W. Rivero, Meridium (previously PDVSA)

The aim of this session is to create an awareness of the need for, and benefits of, upgrading Mechanical integrity (MI) programs to a Risk Based Inspection program for facilities in any industry, and in this case, specifically the Mining industry. A sound MI program will consist of multiple aspects, meant to ensure failure prevention in the operation of a facility when implemented and integrated correctly. Some key components of this program include, documentation, degradation assessments, inspection plans & drawings, inspection data management software, risk based inspection and management of change. Pinnacle recently completed a MI program assessment, and worked with Mosaic's Potash and Phosphates business units to develop a plan for implementation of an RBI program for stationary assets to improve mechanical integrity. The intent of this initiative, when fully implemented, is to provide Mosaic with a best-in-class Mechanical Integrity program. The Mosaic pilot RBI program is currently being implemented for Potash at Esterhazy, Saskatchewan and for Phosphates at New Wales, Florida. The next phase of the MI program implementation is being completed for Potash at Carlsbad, New Mexico and Colonsay, Saskatchewan; and for Phosphates at Four Corners, Bartow, Riverview and South Fort Meade in Florida and Faustina in Louisiana. Pinnacle and Mosaic will present this paper on the Mechanical Integrity Program development methodology.

Afternoon Session:

Upgrading Mechanical Integrity Programs by Moving from Compliance to Reliability – R. Davis, Mistras

All refining and chemical companies in the US must comply with OSHA 1910.119 Process Safety Management of Highly Hazardous Chemicals. Paragraph (j) gives some specific guidelines and requirements that must be met to meet the compliance requirement. The result of compliance to the standard is a safer more reliable facility. This presentation will discuss compliance to OSHA 1910.119(j) Mechanical Integrity. Findings from OSHA National Emphasis Programs (NEP) will be discussed. This paper will look at the multiple elements necessary to attain compliance to the standard. The paper will further discuss the risk reduction and reliability benefits that result in complying with the standard. The requirements for the different equipment types will be discussed with an analysis on how the requirements contribute to safer more reliable equipment. The emphasis of this paper is to identify that a safer more reliable facility is the result of a proactive mechanical integrity program. By compliance to paragraph (j) of the PSM standard facilities avoid fines. The resulting benefit of compliance is safer more reliable plants. Target audience: Plant engineering and reliability management, OSHA PSM and EPA Risk Management compliance managers on an intermediate level.

Getting the Most out of your Inspection Data Management System – E. Heard, Valero Energy

Inspection Database Management systems (IDMs) have evolved greatly since the days of TML point locations. We in these industries generate enormous amounts of data on daily, weekly and monthly basis. What do we do with all this data? As an IDMs admin/lead, our job is not just scheduling UT crews for next inspections. With the addition of RBI, KPIs, ever-changing turnaround/squat schedules, the job we are tasked with is managing this data to help give a correct and confident answer to what may be asked. Some items to consider when managing a system are Correctness, Consistency, Communication, Confidence, and then on the people side of the equation is Coaching. Correctness of data is reviewing files (U1's, construction drawings, etc…) each time a file gets pulled. As these IDMs house a majority of the asset data (design data, P&IDs) that gets used on a daily basis, we have become a main hub of information. So when questions as simple as what P&ID does "X" RV reside on, to what Process Streams and Equipment do we have that operate greater 400°F and have a hydrogen partial pressure greater than 50 psia; we can answer them quickly and correctly. There are two parts to consistency. When starting out as a new site or as a seasoned site with a new task to track, "consistency" is a must. The original path taken may eventually be deemed incorrect. Not a problem, because the data is structured the same, there will be only one solution needed to put this back on track. The second part is users. An example is four complex inspectors entering data four different ways. This will lead to having to manage four reports to pull the same data for each complex. In the previous example ask the complex inspectors why they are entering in reports or other data that particular way. Communicate! Listen to all sides, one complex inspector may have items that are under some Governmental jurisdiction and another does not know by using a certain event they can then track the life of a RV or bundle life. By instilling the previous three topics, it will then lead to "confidence" in the data. The proverbial question of "are you sure?" shall greatly be decreased. It is not only that question being decreased, it's knowing that the product/process is operating within good metal and operating in a safe manner. Coaching is the final topic. Show the folks on your Inspection team how to run and build reports. Discuss what anomalies that get searched for when reviewing data. Explain how UT data gets used in RBI data. There will be one individual that will begin to ask what SQL is and the following Monday SQL for dummies is on their desk. Now we get the "what if" and "can we" questions!

Full-scale Testing of Composite Repairs (Case Studies) – J. Bedoya, Stress Engineering Services

The use of composite materials in high pressure pipeline and piping repairs are becoming commonplace, and as such it is necessary to know the performance

limitations of these materials under different loading and environmental conditions. This study discusses specific applications of composite materials in pipelines in reinforcing defective girth welds, dents, corrosion and elbows and tees, subject to static and fatigue loading and buried conditions. The viability of these repair methods is discussed based on actual testing of these materials in relevant loading conditions. In addition, the standards that govern the use of these materials is also discussed.

Creating and Managing Circuit-Based Piping Inspection Programs – B. McKay, SGS & D. Hendrix, Hendrix Group
Physical piping systems are typically managed using a circuit based approach. The circuit based approach has been used with RBI and non-RBI inspection schemes. Publically available documents such as API 570, reference this type of approach but do not provide specific processes or criteria to aid in creating and managing circuits. Typical industry approaches for creating and managing corrosion systems and circuits are sometimes unrelated to the specific damage mechanisms that may be present. Additionally, the creation of CML's and TML's to accommodate a lack of understanding of the behavior of the damage mechanisms and the resulting risk can create unanticipated issues. Assumptions are sometimes made in the creation of corrosion systems and circuits that have a significant impact on the resulting risk profile for a facility. The presentation will discuss important issues related to corrosion system and circuit development as well as provide practical guidance and criteria for developing and managing corrosion systems and circuits

Inspection/NDE Track:

Morning Session 1:

Summit Kick-Off and Keynote Speaker - John Bolton – Former US Ambassador to the UN – "Threats to American Security: A Closer Look at the World's Trouble Spots and How They May Affect Our Energy Supply"

Infrared Inspection Program for Fired Heater Integrity Management - Tim Hill and Rosalind Julian, Quest Integrity Group
Infrared (IR) thermometry has been used for forty years to monitor tube metal temperatures in refining and chemical furnaces. The application of IR thermometry has often been characterized as highly operator dependent and therefore developed a very poor reputation in the industry from poorly applied and interpreted results. There is no question that when absolute accuracy is unimportant, IR thermometry has proven to be an excellent diagnostic tool for detecting tube hot spots from internal fouling and heat distribution non-uniformity in fired heaters. However, to capture the full capability of IR thermometry, a proven methodology is required to measure accurate temperatures in a

repeatable process. This presentation discusses the particular aspects involved in establishing an infrared inspection program to monitor the integrity of the fired heater tubes, as well as a wealth of diagnostic information that may be used to evaluate the performance and reliability of major fired heater parts (e.g. tubes, tube supports, burners, refractory and structural systems). It describes the key components of an effective IR program by providing proven examples taken from real-world programs. Attendees will take away best practices that may be used at their refinery.

How to Avoid Spills onto Navigable Waters with Rope Access Inspection of Wharf Piping - Steven McGuire, Hawk Rope Access
Inaccessible piping over water is regulated by U.S. Coast Guard and State regulators. Corrosion is a huge issue and inspections from boats, floating staging and walkways provide only limited examination. The accessibility issue is being addressed by the use of rope access with skilled technicians, certified in Visual and Ultrasonic Inspection. Recently six out of 6 wharfs whose piping was inspected using rope access required immediate remedial attention. The rope access specialists remove active rusting by cleaning rust bloom areas to reveal significant metal wall loss. In addition, they lift the piping at each support contact point for a thorough inspection of the entire line. Detailed mapping of corroded areas are accomplished. It has been recorded, that as high as 41% of the areas where corrosion was revealed required immediate attention. This paper will explain the combination approach and detailed reporting as well as the skill requirements for a satisfactory rope access survey. Illustrations will be provided to provide documentary evidence of the hidden corrosion conditions.

Morning Session 2

Summit Kick-Off and Keynote Speaker - John Bolton – Former US Ambassador to the UN – "Threats to American Security: A Closer Look at the World's Trouble Spots and How They May Affect Our Energy Supply"

Automated Weld Overlay Repairs of Large Damaged Equipment – Mahmood Sammon, Houston Engineering Solutions

What You Need to Know about ASME Section V – How It Relates to API In-Service Inspection Standards and New Developments – Jon Batey, Dow Chemical
This presentation will discuss how ASME Codes and Standards in general and how requirements are developed. A brief historical background on ASME Section V will be provided. The relationship between ASME Section V and other Codes & Standards including API will be discussed. Finally, new changes coming in the 2013 Edition as well as developments that may appear in the 2015 Edition will be presented

Afternoon Session 1

A Near Fatal Incident Involving Small Bore Piping and the Corrective Action Inspection Program- Anthony J. Rutkowski, Equity Engineering Group (retired COP)

This presentation will review how a rountine refinery practice caused a near fatal injury and millions of dollars in repairs and lost production. On a 140,000 Crude Distillation Unit a set of, kerosene to the field, heat exchanger was not performing affectively on the shell side. The operators turned a fire monitor spray onto the shell. This is a routine practice in most refineries. The set os exchanger next to the set being spray heated what the operators called "wild naphtha" on its way to the debutanizer tower. It is called that because of the high butane content. The naphtha coolers were insulated and the back cover heads had reusable insulation blankets on them. The overspray from the kerosene cooler's external cooling effort was soaking the back covers head's insulation. A decision was made to pull and clean the naphtha preheaters on the run. As the insulator was removing the stainless steel wires holding the blanket of the top exchanger the blanket fell to the ground. A ¾" bleeder valve on the bottom of the bell head broke off between the valve and the head dumping the butane rich naphtha onto the exchanger below and flooding the area with product. The insulator ran to get an operator but one was in the area and witnessed what transpired. The operator tried to block in the exchangers but the liquid ignited before he could finish. The operator was caught in flames but was able to escape and survive although severely burned. One item to come out of the post incident investigation was "how many more like this are out there"? That initiated a small bore inspection program involving every small bore branch connection in a 340,000 barrel per day refinery. This presentation will describe how that was accomplished and other efforts following the incident.

Heater Stack Integrity Assessment – Before the Next Big Windstorm- Michael Guillot, Stress Engineering Services

Stacks exist in every plant but are often forgotten components until a hurricane enters the Gulf of Mexico and then they become the focal point. Due to their height and difficulty in inspecting them many times significant deterioration occurs before a comprehensive inspection is made. This presentation provides an overview of the problems typically found with stacks. It provides guidance on the locations where problems are commonly found and discusses the corrosion mechanisms responsible for many problems. Once the deterioration is documented its impact on the general failure modes as described in ASME STS-1 is evaluated. An example of a free standing stack is discussed to illustrate the concepts.

What is the ASNT Doing to Assist the Plant Inspection Efforts? – Danny Keck, ASNT Level III, BP America

This presentation will include information on ASNT Publications Department topics such as NDT Handbook development, the Programmed Instruction (PI) self-study Series and our periodicals, the monthly Materials Evaluation magazine and the quarterly newsletter, The NDT Technician, Mr. Keck will also discuss current certification issues and upcoming conferences that will be of interest to the Petro-Chemical industry, especially next June's 13th International Chemical and Petroleum Industry Inspection Technology Conference (ICPIIT XIII).

Status, Recent Changes and Future Plans for the API Inspector Certification Program – Tina Briskin, API ICP Manager

The past, present and future of ICP. This presentation will show how the program has grown in the last decade, especially internationally. The API will show numerous charts highlighting the growth of the program and existing trends. The presenter will describe the new programs currently under development which will be available in 2013 such as Source Inspectors. The presentation will also feature the transition of the exam administrations from paper to computer based testing (CBT) that is likely to occur in the near future. This will explain what is expected to be different with the change to CBT.

Afternoon Session 2

MI Inspection during Capital Projects Promotes PSM Compliance, Corrosion Rate Accuracy, and Improved Budgeting - Travis Keener, SGS

Putting off the initial inspection (i.e. baseline) of piping and vessels in a new process unit is both common and problematic. The tendency is to rely on the nominal thickness because the actual original thickness was either not measured or not recorded. Consequently, significant errors in calculated corrosion rates may result from variations of thickness allowed by mill tolerance standards during fabrication. Not having the original thickness can mask potentially hazardous conditions, or cause concern where none is really warranted. Involvement of the inspection department in a capital project can significantly improve quality, reduce cost, and ensure compliance. The objectives of this paper are to provide: 1) justification for inspection during capital projects; 2) effective roles for inspection departments in capital projects; 3) justification for performing vendor surveillance in capital projects; and 4) the technical advantages from performing pre-service baseline inspections.

Code Quality Inspection through Computerized Radiography – William Bobbitt, PetroChem Inspection Services

Advancements in Radiography in the past decade have been great. Computerized Radiography is no exception, although the mainstay seems to be geared more toward profile and informational inspection. Computerized Radiography is capable of more, but

in order to do so certain steps should be taken. Several factors must be taken into consideration when implementing Computerized Radiography for code quality weld inspection and acceptance. Main consideration should be given to material type, size, and thickness. Other considerations should be given to the type of energy and phosphorus plate used. Protection against backscatter in almost all situations is key. The use of lead screens, if needed. This paper will outline some methodologies used to help establish technique development for code quality inspection thru Computerized Radiography

Recent Developments in the Application of NDT for Improved Integrity Management - Mark Stone, Sonomatic Ltd

Inspection using NDT methods is playing an increasingly important role in the integrity management of safety and business critical equipment. There is a trend away from using inspection simply as a means of providing assurance that the current condition is acceptable towards making comprehensive use of the information obtained as a means of longer term integrity management decision making. A key requirement is that the inspection carried out provide reliable information on the true condition of equipment, even when there may be only early stage degradation present. In order to maximise the benefits of inspection in the integrity management process there is increased emphasis on the reliability and accuracy of the inspection methods used. This paper considers developments in a number of areas in which new approaches to inspection, and subsequent analysis of the data collected, are leading to substantial improvements in integrity management. The areas considered are Non-intrusive inspection of pressure vessels and application of statistical analysis methods to the integrity management of pipework. The paper covers the requirements for NDT feeding into these applications and demonstrates the benefits of enhanced inspection and analysis approaches.

Improved Vendor Surveillance – Two Case Studies Based on Equipment Failures In-Service - Mr. Mohammad Al- Shaiji, Kuwait Oil Company

Ensuring quality while manufacturing equipments for oil and gas facilities is of paramount importance as the consequence of a failure of any equipment can jeopardize the plant and facilities which may be catastrophic in nature. Static & Rotating equipments like Pressure vessels, Heat exchangers, Valves, Piping, Pumps, Compressors etc. are being procured through various projects based on the project Specifications, Company and International Codes & Standards. This presentation comprised of the experiences based on case studies of failures conducted for two equipments which are operating in sour hydrocarbon service. First case study is pertaining to failure of valves of Duplex Stainless Steel (DSS) castings which were procured through an EPC contractor. Second case study refers to detection of cracks on a SS 321 cladded plate of a pressure vessel which was inadvertently placed instead of specified SS 316L cladded plate. Gate

valves supplied by a particular vendor started leaking from the body and bonnet after certain period of service. Investigations were carried out on failed DSS valves & found that the failure occurred due to the formation of intermetallic phases during casting. Hence, it is essential to maintain quality for any casting, especially exotic alloys during manufacturing. To avoid material mix up of Corrosion Resistant Alloys, vendor/manufacturer should ensure proper tagging of components & carry out 100% Positive Material Identification during the manufacturing stage. The presentation deals with the requirements of effective vendor surveillance to ensure that all the requirements of the project specifications are met. Prior to manufacturing and assembly of equipment, vendor shall define QA/QC activities in their Quality plan for the procurement of critical components from their sub vendors. This shall be in addition to vendor's detailed Inspection & Test plans (ITP) of the complete assembly. It is necessary for the Company to conduct Pre- Inspection Meetings (PIM) with the vendor to ensure that the equipment procured shall meet the project specifications & monitor vendor performance during all the stages of manufacturing & testing. This will enable to procure quality products and achieve safe, reliable and un-interrupted production which is vital for any Oil & Gas industry.

Materials/Corrosion Track:

Morning Session:

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In-Situ Weld Repair Techniques and Technology - Darren Barborak, Aquilex Corporate Technology Center

There are many material failure modes such as Fatigue, Fracture, Wear or Erosion, and Corrosion which can be addressed economically in-situ with an Engineered Welded Repair versus disassembling the component for shop repair or replacement. An engineered approached will be discussed, which evaluates many aspects of the repair such as the failure mechanism, repair scenarios, repair access, expected repair life, service requirements, code requirements, welding & NDE requirements, and welder safety. Welding techniques such as temper bead welding, and weld buildup/inlay/onlay/overlay are discussed as well as advanced welding technologies such as remote welding and low heat input modified short circuit gas metal arc welding. Several examples of remote repair are provided including remote inspection, repair, and NDE of buried pipe.

Welding Metallurgy for the Plant Inspector – Jeff Major, Western Refractory
It is well understood that the metallurgy of materials plays a key role in the success or failure within all industrial sectors. Significant research has been conducted to understand the influence of the environment(s) (e.g. temperature, media, flow rates, etc.) on failure or prevention of failure. Through this research, a better understanding into the key mechanisms and adversely the key elements/microstructures that prevent or enhance failure is becoming better understood. Unfortunately, even with enhanced materials they are only as "strong" as their weakest link. In many cases, the weakest links are weld joints. This presentation will focus on the key fundamentals of welding and welding metallurgy. Among inspectors, engineers, or quality control personnel it is well understood that construction within all industrial sectors cannot be completed without material joining. The most popular joining process is fusion welding. To help ensure quality welds, the use of welding procedures that have undergone proof testing is the leading recipe to success. But what exactly do welding procedures relay and how are they developed to ensure sound welds. The first topic of discussion is welding procedures and why they are important. The second topic focus is on welding process fundamentals and their characteristics (e.g. flux decomposition and chemistry, shielding gas and arc physics). The third topic of discussion will be general guidelines for filler metal selection for both similar and dissimilar welding. Finally, a brief discussion on how the previous topics influence the final metallurgy and properties of a weld joint.

Afternoon Session:

Dealing with Carbonate SCC in Modernized FCCU's – Steve Bolinger, BP Texas City-
This presentation discusses an incident in which severe Carbonate cracking occurred in an FCCU gas plant. The carbonate cracking stress corrosion cracking phenomenon occurs in high pH sour waters in the presence of CO2. During this incident many cracks were found and a large amount of piping and equipment was replaced. Additionally, all new equipment required PWHT and higher than normal temperatures in order to prevent cracking from occurring in the future.

PTA SCC Leaks on Incoloy 800 REAC Header Boxes – Art Jensen, Delaware City Refining (PBF Energy) and **Avoiding PTA SCC Leaks in Refining Equipment** – Gerrit Buchheim, Consultant, Marc McConnell, PinnacleAIS
During the restart of a high-pressure hydrocracker at the Delaware City Refinery there was a small weep-type leak detected at a flange weld on an Incoloy-800 reactor effluent air cooler (REAC) header box. X-ray examination indicated crack-like damage characteristic of polythionic acid stress corrosion cracking (PTA SCC). The unit was shut down and the flange and weld were cut out for examination, which verified the PTA SCC damage mechanism. More than 30 other similar weld locations were examined on the

REAC system, but no additional cracking was detected. While hydrotesting the equipment following the repairs another weep-like indication was noticed on one of the REAC header boxes, which was also determined to be a crack-like defect consistent with PTA SCC. Further investigation identified the source of this damage and established the remaining useful life of the equipment. This example will emphasize the importance of understanding equipment design, metallurgy, process environment and damage mechanisms, and also the importance of knowing the full equipment history toward understanding causes of current problems.

Case Studies on the HIC Damage Mechanism – Jim McVay, Tersoro

Historically with many refiners Hydrogen Induces Cracking (HIC) was thought a relatively benign damage mechanism affecting carbon steel in sour water services and very simplistic and basic criteria was often used to assess to serviceability of HIC damaged equipment. With the advent of modern analytical tools to assess detected HIC damage, however, many of these same defects accepted historically may fail industry standard Fitness for Service (FFS) assessments for continued operation at current mechanical ratings. This presentation will: Discuss service and material conditions promoting the occurrence of HIC damage, Discuss current common NDE methods and effective application of those methods to detect and characterize HIC damage, Discuss possible RBI-based inspection strategies to detect and monitor HIC damage. Discuss the use of the analytical tools in API 579 to perform FFS assessments of HIC damage. Recent case studies of equipment with HIC damage will be reviewed to support the discussion outlined above.

The Need for PWHT and Out-Gassing After Welding Repairs on Equipment Operating in Potential Environmental Cracking Services – Gerrit Buchheim, Consultant and Mike Urzendowski, Valero

One of the most common issues that refiners face during a shutdown is whether PWHT is needed subsequent to minor or major weld repairs on equipment and piping. There are some API 510/NBIC Code issues, but in many cases it the service environment that determines the need for PWHT. Another issue that often arises is whether equipment in wet H2S service needs hydrogen outgassing before making repairs. The panelists will prepare a few discussion points on PWHT and outgassing issues and the rest of the time period will be spent fielding questions from the audience on their experiences and the panelist will try to provide suggestions.

Wednesday, January 9:

Engineering/Analysis Track:

Morning Session:

Coke Drum Life Extension Issues and Solutions for Inlet Nozzle Problems – Richard Boswell, Stress Engineering Services
Modern coke drum operations are used to process a heated mixture of hot liquid and vapor inside a vessel where the residuums produce more valuable liquids and gases while leaving large amounts of solid or semi solid carbon. The batch process is a cycle of filling, cooling and removing the solid content. Coke drums suffer fatigue damage from several causes which can be accelerated if not managed properly and these can lead to premature and repetitive cracking.
Traditional Analysis methods assume a uniform average flow of water upwards to remove heat from coke bed and shell at the same time, or flows up thru central primary flow channel. The coke bed formation determines path of least resistance for water flow. Temperature measurements suggest fast quench with flow near wall is common with the use of side inlet feed configured drums making shot coke. This creates greater stress in shell/cone-cladding bond and at skirt weld. Coke drums suffer fatigue damage from several causes which can be accelerated if not managed properly and these can lead to premature and repetitive cracking. Solutions focused on a single cause may overlook the other contributors today or in future operating conditions. Inspections that discover the extent of damage can be supplemented with active measurement of strain and temperature during the cycle to establish statistically relevant causes for low cycle fatigue failure. The drum geometry evolves from a cylindrical like object into a highly corrugated vessel which amplifies wall stress and accelerates local damage. Geometric degradation and crack growth are increasingly nonlinear in time and inspection programs must be designed to anticipate this to avoid unplanned outages for repairs. Drum bulge severity can be evaluated with finite element model analysis to determine the amplification potential, and to plan when and where areas should be inspected closely. Thermal distributions during quench show large differentials between sides and elevations when cooling water quenches the steel and not the coke. This is influenced by orientation of the inlet nozzle. Traditional bottom center feed creates the least trouble compared to single or dual side inlets, but is not trouble free because of the way shot coke forms and moves inside the drum. These configurations are discussed in comparison to new technology which restores vertically aligned flow streams when slide valve un-headers are used for safe removal of the coke solids. This technology can extend the economic life of old and new drums.

Failure Modes and Inspection Needs of Coke Drums - M. Samman & Tim Schmidt, Houston Engineering Solutions

Coke drums are large vertical refinery vessels that operate in cyclic batch process under severe mechanical and thermal loads. Many drums start to experience failures within three to five years of service. Typical failures include shell bulging and cracking, skirt attachment cracks, anchor bolt failures, tilting, and vibration failures. Some of these mechanisms can lead to unscheduled shutdowns, loss of containment and fires. This presentation is an overview of these failure modes, their causes, consequences, and the inspection methods that can be used to detect and characterize them. In addition, the presentation will discuss the industry's experience and lessons learned from these failures and the advantages and disadvantages of various inspection techniques.

Case Study – Planning and Implementing a Successful RBI Program – M. Harmody, Equity Engineering and R. Corn, Marathon Petroleum

As refiners continue to operate aging infrastructure, safe operation and equipment availability continue to be key components of profitability. When considering optimizing inspection projects, more and more refiners are making Risk-Based Inspection (RBI) an integral part of their plan processes. When applied properly, RBI can refocus inspection efforts using risk as a basis for prioritizing and managing an in-service inspection program. 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 *Risk-Based Inspection Base Resource Document*. The concept behind these publications was for API 580 to present the principles and general guidelines for RBI while API 581 provides the quantitative RBI methodology. The key concept in RBI methodology is the systematic determination of the probability and resulting consequence of an undesirable event.

Over the course of 3 years, the principles of API 580 and the technology of API 581 have been successfully applied to majority of the process units at the Illinois Refining Division of Marathon Petroleum Company. Through planning, training and plenty of hard work, the RBI program at the Robinson Refinery has been very successful. This paper provides an overview of the concepts in API 580 and API 581, a discussion on the steps taken to lay the groundwork for the RBI program to be successful, examples of where the program has been successful, and plans for the future.

Case Study – Handling Issues That Arise in a Plant Wide RBI Implementation – S. Bolinger, BP Texas City

The BP Texas City refinery has performed an RBI analysis on all Tanks, Pressure Equipment and Piping at the site. This paper will present the findings and risk ranking for all the equipment in a risk matrix format. The risk ranking of piping is not common in industry and some of the findings are discussed such as high risk circuits due to cracking. The paper discusses further several issues that naturally arise when the

program is fully implemented. Such as how and when inspections should be performed on piping, when does a site switch from rule based to RBI based intervals for pressure equipment and how deferrals should be executed when the inspections required extend past the RBI due dates. Additional discussion regarding extending tank intervals past RBI and rule based due dates. Currently, there is little industry guidance on how these types of decisions should be made in an RBI based inspection program.

Afternoon Session:

Case Study - PRV RBI Analysis Without Using Commercial Software – L. Ward, Siemens
The purpose of this presentation will be to demonstrate a method for using Risk Based Inspection (RBI) in the analysis of a Pressure Relief Valve (PRV), including the theory of API 581, based on an actual completed project (company to remain anonymous). The presentation will focus on how the PRV RBI methodology evolved, was developed, and then implemented.

The presentation will also include how equipment and piping RBI analyses were utilized and the extra challenges to develop the risk matrix for that effort, and how it was difference from the risk matrix that was used for the PRV RBI analysis, and also how adjustments were necessary regarding the difference risk matrices.

Details of Consequence of Failure (COF) and Probability of Failure (POF) regarding PRV's will also be presented. Consequence of Failure was analyzed by looking at the types of overpressure scenarios; the discharge location of the relief valves(s), and if there were multiple relief valves in parallel. Probability of Failure was analyzed by looking at the number of overpressure scenarios, fluid service severity, relief valve type, if a rupture disk existed upstream of the relief valve, and inspection history. The resulting risk, recommended inspection interval, and next inspection date will also be presented.

How to Choose the Best RBI Program for Your Plant – Five Key Factors – A. Hilmi, GL Noble Denton
If used correctly, RBI can be an excellent tool in managing the integrity of assets. Experience has shown that having the right risk based integrity management strategy will significantly improve process safety. An RBI output will enable operators to prioritise inspection and corrosion monitoring effort on higher risk assets. Conversely, there have been instances where the operators have found out that their current RBI system has not performed as planned. In this paper, five key factors that operators should be aware of before setting up an RBI system will be presented. For operators who are intending to introduce RBI to the organisation, this discussion will assist them to make a more informed decision before investing in a particular RBI system. For

operators who already have a sound RBI in place, this paper may provide some ideas for improvement

Case Study – Effective Integration of RBI & FFS from Equipment Cradle to Grave – A. Seijas, Phillips66

Managing the life-cycle of fixed equipment in petrochemical plants is a tough business. Fortunately, Fitness-For-Service (FFS) and Risk-Based Inspection (RBI) are two widely accepted stand alone methodologies that can work together perfectly facilitating the management of asset during its lifespan. The API/ASME Standard on FFS provides quantitative engineering evaluations to demonstrate if an in-service asset (asset or component) containing a flaw or damage is safe and reliable to operate under specific conditions during a defined period time; evaluation techniques also consider the assessment of asset operating under conditions where there is risk of failure. API published two recommended practices to quantify the risk of operation for process equipment, providing owner-users to define inspection strategies and programs to manage the risk of their assets. This paper will describe the most relevant advantages of integrating RBI programs and FFS applications as part of the overall asset management program, covering different stages of the life cycle, including construction and commissioning, operation, inspection, engineering assessment, alteration/repairs, and decommissioning. A comparison between the non-integrated /reactive and the full integrated RBI-FFS/proactive approaches will be discussed. A case study is presented to explain the benefits of implementing an integrated RBI-FFS approach. Finally the paper will summarized the challenges to implement integrated RBI-FFS/proactive programs, specifically those face by practitioners (inspectors/chief inspectors/engineers), reliability teams, and management. This paper is intended for unit inspectors, chief inspectors, and maintenance and reliability engineers.

Demonstrating Value from the RBI Process - Understanding and Managing Uncertainty – Greg Alvarado, Equity Engineering Group

Consistency and adherence to inspection effectiveness confidence level rules are important in the RBI process and for managing uncertainty. This presentation will cover the impact of uncertainty in the Risk Management process and practices for creating and interpreting inspection effectiveness tables that comply with API RP 580 and API RP 581. As Bayesian logic is used in the 581 RBI technology and process, a thorough explanation of the sensitivities and importance of realistic and consistent application of rating inspection effectiveness is critical to accomplish a credible, effective and sustainable RBI program. All RBI practices in the process industries are based on relative risk. As a result, if we lose consistency and credibility the risk rankings are of little practical good. The focus of this presentation is demonstrating value in the RBI process via effective management of uncertainties, how to achieve this credibly and consistently

and the role of inspection in understanding, measuring and managing the impact of uncertainties.

Inspection/NDE Track:

Morning Session 1:

Pipe Hangers/Supports Inspection: What is Involved and What to Look For - Lange Kimball and Britt Bettell, Stress Engineering Services

The API and ASME Piping Codes have long recognized the need to perform regular monitoring of pipe supports and restraints at refineries and power plants. This is true not only of existing plants but also of new plants. The condition of pipe supports and restraints is an external barometer of hidden problems with the piping and attached equipment. Recognizing pipe support and restraint distress can help prioritize pipe inspections and equipment maintenance. The first part of such a surveillance program is setting up the program. This should include: a.) defining the piping systems that will be monitored, b.) collecting survey documents, c.) setting up a schedule to perform the work, d.) training plant personnel who will be performing such a program and e.) obtaining a commitment by the plant/owners to maintain the program through the life of the plant. This paper discusses experiences and lessons learned setting up such programs. Topics will include: 1.) what is a pipe support and restraint, 2.) types of pipe supports and restraints, 3.) purpose of inspections, 4.) API 570/574 considerations, 5.) what we look for and 6.) how results are reported.

A New Technique for Quantification of Corrosion at Structural Supports - Gary Kroner, Carbon Steel Inspection, Inc.

Process, transfer lines or structural piping that requires physical supports usually creates a potential corrosion site. These metal to metal or metal to insulation contact areas could be considered as pads and sometimes require a significant amount of resources to remove and inspect. A new technique developed by CSI called Guided Current Testing (GCT) uses electrical current to push through the conductive material of interest. Based on the material conductivity and thickness, current can be applied at varying frequencies and with sensors placed at various distances to measure basic physical material properties and test parameters. These properties and parameters are directly related to the thickness of the test specimen. As wall loss or remaining wall thickness is the critical variable in the test specimens' integrity it is estimated via distance amplitude curves. The amplitude can be any component of the material property or electrical test parameter. The amplitude change in the material property is primarily caused by a dimensional change in the test specimen; therefore a baseline reading is required to determine the nominal reading. Once a benchmark reading is obtained then the

calibration or reference standards are helpful to improve accuracy for any given test but are not necessary as the wall loss depth estimation curves can be extrapolated from other distance amplitude curves or known values. The technique is extremely repeatable and consistent enabling it to be used as a trending inspection for corrosion rates and life assessments This new NDE inspection technique is targeted to the Reliability Engineer and Inspection departments to provide a tool to obtain information in areas that previously are difficult or unobtainable. The equipment and test measurements are relatively inexpensive and fast as compared to other testing equipment on the market. Additionally, technician training and implementation is more conventional than advanced techniques such as Shear Wave, Phased Array and Guided Wave. All techniques including GCT have advantages and disadvantages which will be presented in the paper along with some of the variables effecting the measurements.

Inspection of Raised Face HF Alky Flanges with Phased Array - John Sellers, PetroChem Inspection Services

Corrosion at petrochemical and refining facilities will always be a major concern for piping integrity. HF Alkylation units face an unusual type of corrosion that attacks the raised gasket seating surface of the flanges. Safety conditions associated with the product as well as access to the area of interest effect the ability to inspect these areas reliably. Identifying appropriate inspection methods and tools is essential in establishing a good inspection program of these flanges. Several factors must be taken into consideration when implementing the inspection of the HF Alkylation units, first and foremost is safety. Others are access, timeframe, tracking and cost. There are only a few ways to inspect these flanges to determine if they are fit for continued service. A commonly used method in the industry today is to visually check each flange set during an outage by using a straight edge on the surface and measuring the damage to see if it is in the gasket seating area. This puts the inspector at greater risk of exposure to the product and forces the Owner of the equipment to wait until outage for cost of replacement. Phased Array technology can be utilized to screen many of the flanges in service, thus reducing exposure risks and providing estimated replacement projections in time to budget for outages. This paper will outline some methodologies used to inspect these flanges and what the benefits are for doing so. The employment of pre assessment, indirect/direct inspections and post assessment can prove to be valuable instruments in obtaining an effective inspection.

A Best in Class Approach to Fixed Equipment Turnaround Management - Nathaniel Ince and Brad Wells, Pinnacle AIS

The goal of this presentation is to communicate best in class mechanical integrity in regards to turnaround management. While mechanical integrity programs are now

being implemented and supported from an integrated perspective (integrating operations, process, maintenance, lab information, IT, etc.), turnaround management needs to be handled in the same way. Several mechanical integrity responsibilities must be incorporated to successfully execute a turnaround, including inspection planning, inspection staffing, inspection execution, corrosion specialist support, engineering support, and inspection documentation. Traditionally these responsibilities have been handled through a segmented effort, resulting in poor interfacing and slow decision making. To ensure a turnaround is both streamlined and valuable, each of these somewhat independent responsibilities must be viewed from a holistic perspective. Usually, this process would be laborious, time intensive, and costly. Best in Class Turnaround Management utilizes a process that provides for effective and quick decision making, resulting in reduced risk, optimized asset life, and maximized uptime, and increased personnel efficiency. In this presentation, we will discuss: The type of team it requires to provide for best in class turnaround management; The type of systems and interfaces required to ensure effective communication between the team members; The timeline expectations for different activities, including inspection planning, inspection reporting, fitness for service assessments, corrosion specialist feedback, repair/replaced recommendations; The level of turnaround planning involved, in addition to the training of the turnaround inspectors. Also, during the presentation, an example will be provided to illustrate the point. In short, one piece of equipment will be taken through the management process, and inspection plans, inspection feedback, engineering decisions, and implementation actions will be demonstrated.

Morning Session 2:

Field Applications of Long Range Ultrasonic Testing: Benefits and Limitations - Scott Taylor, ConocoPhillips

Long range ultrasonic testing (LRUT) is a guided wave screening technique for damage to pipelines. As part of an integrity program, LRUT can provide inspection information about hard to reach areas such as offshore deck penetrations or road crossings. The Alaskan North Slope uses LRUT to screen drill pad, road, and caribou crossings as the only other inspection recourse is to dig the crossing, cut open the casing, and examine the pipe directly. Similarly, in offshore situations, LRUT can assess pipe integrity at deck penetrations and pipe supports where a direct examination is expensive. However, LRUT as with other NDT approaches has its limitations. This presentation will introduce the LRUT and discuss data obtained under different scenarios: pipe supports (both welded and fiber reinforced plastic), foamed-in-place anchors, road crossing, buried pipe, offshore deck penetrations and pipes with different coatings. As these examples are presented, the advantages and disadvantages of the technique will be discussed.

EMAT Solutions for In-Service Inspections - Borja Lopez, Innerspec Technologies
Electro Magnetic Acoustic Transducer (EMAT) is a non-contact, couplant-free ultrasonic technique that generates sound in the part inspected. This method of ultrasonic nondestructive testing has recently become very popular for corrosion detection on pipelines and high-temperature measurements. In this paper we present a complete overview of existing and new applications for EMAT including: Normal beam (0º) inspections at very high (650ºC) and very low (-50ºC) temperatures; Corrosion monitoring with permanent sensors; Austenitic weld inspection using Shear Horizontal sensors; High-temperature weld inspection; Thin weld (<6mm) inspections using guided waves; Detection of corrosion under supports and on air-to-soil interfaces; Surface wave inspections; Measurement of material properties (stress, anisotropy, bolt-load); In-Line-Inspections (ILI). This paper will present the techniques and equipment used on these applications as well as future trends for EMAT technology and its applications in Midstream and Downstream.

EMAT Ultrasonic Guided Wave Inspection of Pipelines - Mark Adams, Spectrum Sales and Services
Inspecting pipelines using a couplant free ultrasonic guided wave system called EMATs (electromagnetic acoustic transducers) are simply a coil of wire in a magnetic field. By pulsing an electrical current through the coil, an eddy current is induced in the surface of the nearby conductive material; the magnetic field interacts with this eddy current to produce a mechanical force on the surface to excite ultrasonic vibrations. The same configuration of coil and magnet also detects mechanical motion of the surface because the motion of a conductor in a magnetic field produces currents that are detected and measured by the near-by coil. One of the most useful properties of EMAT technology as an inspection technique is its ability to generate the guided waves without having to worry about coupling, due to the non-contact and couplant-free nature of EMAT transducers. This ability enables EMAT technology to generate ultrasonic guided waves and scan the transducers over the inspection area at the same time. Our company has recently started to utilize our EMAT technology and developed a subsea pipeline inspection system called Magna Subsea Inspection System™. This EMAT technology is applied to the subsea pipelines for non-piggable pipelines, jumpers, risers and flow lines on the ocean floor. We have inspected two of the world's largest Pipelines using our EMAT technology.

Practical Applications of Guided Wave Inspection: A Technician's Perspective - Mike Sens, PetroChem Inspection Services
Guided Wave Pipe testing is a specialty Ultrasonic method that can inspect various lengths of piping from a single location for a variety of damage types or situations. Guided Wave testing can be applied in numerous applications; piping in pipe racks for

CUI, piping in pipe racks for corrosion damage at supports, sleeved piping such as road way and rail crossings, dock piping for external damage from environment, elevated inaccessible piping on structures or equipment, buried piping for general condition, piping through tank dike walls, piping through concrete walls, piping with internal erosion potential from product flow, etc…Although Guided Wave testing has gained some notoriety as an inspection method it has also fell into disrepute with some for inappropriate use or impractical expectations. This presentation will cover actual capabilities and what to expect for results on the above listed types of applications based on technician field experience with validated findings. False expectations such as type of results to expect and exaggerated capabilities will be addressed. Actual benefits and how to effectively utilize the technology will be addressed. Reported results and general Guided Wave inspection reports will be analyzed. What level and type of training / certification / experience should the technicians have and what end user should look for in a quality guided wave inspector.

Non-Intrusive Inspection of Above Ground Storage Tanks – Sam Ternowchek, Mistras Group

Afternoon Session 1:

Using Risk-Based Approaches to Define and Adjust CMLs, Inspection Techniques and Inspection Intervals - Lynne Kaley, Trinity Bridge and Virginia Edley, SBK Consulting
Do you struggle with how to change your routine inspection program to better define condition monitoring locations based on risk? Is your fixed interval inspection program optimized to inspect more where needed and less where not needed? Today with Inspectors having to do more with less, it is even more important to optimize where to inspect and how to inspect. The presentation will propose a process for using risk-based criteria to define methods, extent and frequency of inspection for equipment and piping. This method can be used to optimize the condition monitoring locations, coverage and maximum inspection intervals, considering the type of damage, the rate of damage and the consequence of failure. The inspection prioritization method can be applied without a risk-based inspection approach as well as to any risk- based methodology. Case study examples will be presented.

The Impact of NDE on RBI Inspection Effectiveness - Anthony J. Rutkowski, Equity Engineering Group
Do you struggle with how to change your routine inspection program to better define condition monitoring locations based on risk? Is your fixed interval inspection program optimized to inspect more where needed and less where not needed? Today with Inspectors having to do more with less, it is even more important to optimize where to

inspect and how to inspect. The presentation will propose a process for using risk-based criteria to define methods, extent and frequency of inspection for equipment and piping. This method can be used to optimize the condition monitoring locations, coverage and maximum inspection intervals, considering the type of damage, the rate of damage and the consequence of failure. The inspection prioritization method can be applied without a risk-based inspection approach as well as to any risk- based methodology. Case study examples will be presented.

Robotic Crack Detection for Delayed Coke Drums using ACFM - Jacqueline Cameron, CIA Inspection Inc

Since 1993, CIA Inspection (CIAI) has been operating a laser profiling service that locates and measures distortion areas in coke drums. To date, CIAI has performed nearly 1000 inspections on operating coke drums throughout the world. During these inspections, many crack type indications have been identified with the visual inspection system but the existing technology was unable to validate or quantify the nature of these indications. As part of its ongoing in-house research efforts, CIAI embarked on a program to design, build and test a robotically deployed sensor which could identify, validate and quantify crack type indications in live coke drums without shutting down the process using a customized ACFM probe and crawler. This presentation will describe the concept and provides an update on the current state of the program, focusing on the results of recent field trials at several refineries in North America. They will discuss ongoing efforts at their respective sites to further the development and implementation of this unique tool.

Afternoon Session 2:

The Evolution of the API UT Examiner Qualification into Four Phases – QUTE/QUSE/QUTB/QUPA- John Nyholt, BP

After a decade of API UT Examiner Qualification testing, the exams are being updated to reflect performance trends against industry expectations as well as expanding into additional ultrasonic test methods. This presentation will review past exam performance measures, pass / fail rates and evolving UT technology and industry needs. The API QUTE Exam has expanded from a fundamental UT weld flaw detection and characterization test to UT crack sizing (QUSE), tank bottom thickness measurement (QUTB) and UT phased array weld flaw detection and characterization (QUPA). This presentation will discuss exam results to date including performance measures, common reasons for exam failure, and recommendations on how to prepare for future API UT examiner exams.

New-Generation Portable Phased Array Systems - Patrick Tremblay, Larry Mullins, Laurent Enenkel, Zetec

Moore's law states that computer power doubles every eighteen months. This exponential improvement has dramatically enhanced the impact of digital electronics in nearly every segment of the world economy. It also applies to the non-destructive testing industry. The first generation of portable phased array UT systems has hit the market in the early 2000's. The massive adoption of these devices has been a game-changer for ultrasonic inspections of critical components in oil & gas, aerospace, heavy industry and power generation plants. Being given their relatively low computing power, operators have learned to deal with the intrinsic limitations of the older portable PA systems to a point where it has became normal to limit the number of focal laws, the data quality and/or the data file size. This paper will show how enhanced computing power of new-generation portable phased array UT systems allows breaking the barriers to truly efficient data acquisition. In particular, we will explain through representative user cases how more focal laws, more amplitude resolution and larger data file size allows more efficient inspections.

Inspection Alternatives for Touch Point Corrosion at Pipe Supports- Mike Wechsler, Mistras Group

Due to recent failures, and the aging infrastructure, piping circuits and supports are becoming more of a focal point for inspections. However, most are unaware of technologies currently being utilized to aide in these types of inspections. We will discuss an ultrasonic technique to aide in determining if corrosion exists at the support locations and approximately how deep the affected areas are.

Leveraging the Use of Permanently-Mounted High Temperature Wireless UT Sensors - Hamed Bazaz, BP

Controlling corrosion is one the biggest challenges in the oil and gas industry, with vast expanses of pipelines and metal exposed to harsh temperatures and processing environments. Oil reserves being discovered today are heavier, more sour, and contain different contaminants than the light sweet crudes of the past. New technologies developed by BP and partners are leveraging a unique combination of science and electronics to keep the threat of corrosion at bay. In collaboration with Imperial College London, BP has developed a new ultrasonic spot sensor which can be permanently attached to the plant (e.g. piping, vessels, tanks, etc.) at temperatures up to 600º Celsius. This revolutionary device is wireless-enabled and has a resolution capable of detecting small changes (±0.1mm) in wall thickness due to corrosion. Once installed, repeated measurements can be taken without access, except to change the battery every 5 years. The sensor is particularly well-suited for areas of the plant that are difficult to access by inspection personnel. The technology has been commercialized

and available through Permasense, a spin-off of Imperial College. Today, the Permasense sensors have been installed in all BP-operated oil refineries globally. Continuous wall thickness monitors are helping to alert corrosion engineers on a real-time basis, preventing leaks and changing the way BP approaches corrosion management. The implemented technology is being leveraged to enhance safety, monitor equipment health, optimize process control, inform maintenance schedules, and quantify the performance of barrier systems.

Materials/Corrosion Track:

Morning Session:

Understanding and Inspecting for Naphthenic Acid Corrosion – Joyce Mancini, BP Texas City

As stated in API-581, "While various papers have been presented on naphthenic acid corrosion, no widely accepted correlations have yet been developed between corrosion rate and the various factors influencing it." As a result, there are a lot of misperceptions for both prediction and prevention of this specific corrosion mechanism.

Increasing demand on the oil market has raided interest in oils with high naphthenic acid concentration. These so called "opportunity crudes" are also referred to as "lower quality" corrosive crudes due to their high naphthenic acid content. As a result, refinery Inspectors have to adopt special strategy for monitoring the mitigating efforts of acidic crude oil corrosivity and monitoring where the effects are going to cause corrosion. This presentation will address the known facts for naphthenic acid. It will cover the effect of naphthenic acid concentration, the combined effects with sulfur, temperature, metallurgy and more.

How to handle the Corrosion Aspects of Opportunity Crudes– Hearl Mead, Shell Global Solutions

Over the past few years increased feedstock flexibility has become an increasing reality for refineries to be a viable and profitable business. Gone are the days when as a corrosion engineer can set the operating limits to run sweet, non-corrosive crudes, and reject all other crudes. A profitable refinery requires processing of more difficult crudes, increased volumes of spot cargoes, and rapid response to crude acceptance requests. Reliability and process safety events have occurred from changes in crude supplies or varying crude blends and quality. These events can eliminate all profits gained from opportunity crudes. A robust end-to-end process is required to proactively manage these threats. This presentation will focus on the involvement of corrosion and inspection engineers in Crude Flexibility Reliability Management – management of

change, inspection strategies, monitoring, CCDs, RBI, equipment integrity, corrosion models, downstream units…

Case Study of an Unusual Lower Temperature Naphthenic Acid Corrosion Failure – Mike Urzendowski, Valero

It has been stated in many technical publications, that Naphthenic acid corrosion (NAC) occurs at temperatures greater than 450°F (232°C). Because of these statements and beliefs, many organizations do not inspect specifically for the localized corrosion that is associated with NAC, nor do they inject Naphthenic acid inhibitors to prevent against such attack. Recently, there has been mention of failures in streams having operating temperatures less than 450°F that have been attributed to NAC, either in whole or in part. Valero recently experienced one such failure, believed to be caused by NAC, at their Port Arthur refinery, in a LVGO stream which operates with an average process temperature of 400°F. This presentation describes this failure and what are believed to be the contributing factors which helped to promote this attack at seemingly cool temperatures, well below what is considered the "norm" for this mechanism

Solving Overhead Corrosion Problems – Successful Case Studies – George Duggan, Baker Hughes Corp

Corrosion in refineries results in substantial costs, approaching $2/barrel of crude processed. Managing refinery corrosion starts with an investigation into the underlying causes. Mitigating corrosion is, in some cases, focused on metallurgy and corrosion inhibitors. However, in the case of overhead system corrosion, a wide variety of options exist to address the corrosion impact, including contaminant control, operating targets, equipment re-design, chemical treatments and metallurgy. A successful mitigation strategy should consist of those steps that provide the lowest cost of operation for the refiner. This presentation describes the techniques used to diagnose overhead system corrosion and select an appropriate mitigation strategy. Examples of successful outcomes are included.

Afternoon Session:

Highlights of API 939C – Avoiding Sulfidation Failures - Gerrit Buchheim, Consultant – Included in Sulfidation Panel Discussion

Sulfidation of Low Silicon Components - Case Study – Clay White, Phillips66 - Included in Sulfidation Panel Discussion

Sulfidation Leak on Crude Unit Piping – A Significant Near Miss– Art Jensen, Delaware City Refining (PBF Energy)- Included in Sulfidation Panel Discussion

Sulfidation Panelist – Jessica Stankiewicz, Chevron Richmond Refinery

Corrosion Control Documents- the Indispensable Guides to Inspecting for Plant Damage Mechanisms-Hearl Mead, Shell Global Solutions

This presentation will show how valuable CCDs are (or can be) to the corrosion and inspection engineer to be pro-active in enhancing process safety and equipment reliability at their site. The presentation will cover a brief description of how reactive life as a corrosion engineer was without CCDs, the content of a strong CCD, who should be involved, and how it should be maintained. A CCD that is written by a team of experts and set on the shelf as "job completed" is pretty much useless, or not useful beyond the memory of the team that developed it. The CCD has to become a tool for the corrosion, inspection, and process engineers, as well as unit operators.

Thursday, January 10:

Engineering/Analysis Track:

Morning Session:

Optimizing the Minimum Pressurization Temperature for Hydroprocessing Reactors– R. Brown, Equity Engineering

Heavy wall low-alloy hydroprocessing reactors are designed to operate at high temperature and high hydrogen partial pressures. This operating environment results in two main factors that affect the specification of minimum pressurization temperature (MPT); long-term temper embrittlement and embrittlement caused by the hydrogen charging within the reactor pressure boundary. During startup and shutdown conditions is when the vessels are most vulnerable to potential brittle fracture and hence the need for controlled pressurization/de-pressurization and heating/cooling rates. Along with establishing the minimum safe operating limits, the optimization of start-up and shut-down of heavy-walled reactors (MPT envelope definition) has the potential to save significant time and related cost per unit shut-down cycle, while maintaining acceptable risk tolerance. Many companies are seeking to optimize their procedures by using faster heating/cooling rates, allowing pressurization at lower temperatures, and/or cooling with hydrogen instead of liquid nitrogen. Provided in this paper is an overview of the objectives of MPT optimization and the critical factors related to structural integrity that affect startup and shutdown duration. A methodology to establish the MPT envelope will be provided and reviewed in comparison to the current draft API 934-F recommended procedure. Considerations for both aged reactors and modern 2-1/4Cr-1Mo and vanadium enhanced materials will be reviewed.

Highlights of Recent Revisions/New Articles of ASME Std PCC-2, Repair of Pressure Equipment and Piping – S. Roberts, Shell Global Solutions

The third edition of ASME PCC-2, the 2011 edition, has been issued and contains 28 articles describing a wide variety of techniques used to repair pressure equipment and piping. The intent of the document is to provide recognized and generally accepted good engineering practice in repairs. While it is not a code, the intention is that it be referenced by post construction inspection codes, such as those issued by API and NBIC. It includes repairs using welding, those using mechanical devices such as clamps, repairs using non-metals such as composite wraps, and guidance on examination and testing. This presentation provides an overview of the current edition of ASME PCC-2, as well as potential future repair articles that are under development.

Case Studies – Cost Effective Improvements for the Reliability & Integrity of Fired Heaters – Tim Hill and James Widrig, Quest Integrity

Fired heater reliability has been a critical economic determinate to today's refinery integrity management programs. Unreliable operation due to radiant or convection tube failures of these non-spared assets can quickly lead to millions of dollars in lost profits. These tubes are only one part of a complex furnace system and the performance of other associated components can result in integrity issues as well. This presentation outlines approaches to operate and maintain all fired furnaces within a refinery using best practices that minimize risk, minimize the amount of maintenance and inspection shutdown work and maximize performance. It describes how to monitor performance and reliability of a fired heater and use this data to evaluate operating risk, fitness-for-service and remaining life of critical components. Case study examples will illustrate the integrity management process for real world fired heaters. Attendees will take away best practices that may be used to manage the integrity of all critical assets at their refinery.

Challenges in Remaining Life Assessment of Furnace Tubes - Antonio Seijas, Phillips66

Afternoon Session:

How to Conduct the Right Inspections for Effective FFS Analysis – M. Jafari & Steve Wickerson, Mistras Group

Since 2001, API 579-1/ASME FFS-1, "Fitness For Service" (FFS) document has been utilized by many professionals in the chemical and petroleum industry to mitigate the risk of operating process equipment with possible anomalies. A FFS assessment is an engineering analysis of equipment to determine whether it is fit for continued service. The equipment may contain flaws, may not meet current design standards, or may be subject to more severe operating conditions than the design conditions. The product

of an FFS assessment is a decision to safely operate the equipment as is, or to alter, repair, monitor, or replace the equipment. The data required for a for a FFS assessment depend on the flaw type or damage mechanism being evaluated. Data requirements may include: original equipment design data, information pertaining to maintenance and operational history, expected future service, and data specific to the FFS assessment such as flaw size, state of stress in the component at the location of the flaw, and material properties. Data requirements specific to a damage mechanism or flaw type are covered in the Part containing the corresponding assessment procedures. However, in compiling these data often inspectors do not pay enough attention to the detail of what is required. Often the FFS engineer have to ask for more information which may lead to re-inspection of the same equipment and create delay and more cost for the evaluation. This paper presents the requirements for inspection as outlined by the API 579-1/ASME FFS-1 for various damage mechanisms and educates inspectors on gathering the appropriate data for engineering assessments. This will help the FFS engineer to perform the evaluations on a timely manner which ultimately reduces the costs for owner/user organizations.

Case Study - Using Laser Scan Technology to Speed Up & Improve Inspection Effectiveness for FFS Analysis– S. Bouse, Stress Engineering Services.
Recent advances have enabled the performance of FFS assessments of bulges, distortions, corroded regions, and crack-like flaws in a much shorter time frame than could previously have been achieved. These advances now permit preliminary Level 3 assessments of distortions to be performed within 3-4 days of initial request, and within 4-6 days for crack-like flaws. These times compare favorably against historically longer time required for complex distortion and crack-like flaw analysis with prior methods. Much of the improved analysis speed has been derived through the use of laser scan technology and close coordination with service contractors (CIA, Meridian, etc.). Coordinating our efforts with a laser scan contractor allows us to focus more quickly on the assessment, and spend less time in data manipulation. The system and procedures we use were developed to work with a wide variety of input data formats, mitigating dependence on any one survey contractor to deliver these rapid results. This presentation will discuss the timeline and methods of a recent case study, from start to finish, culminating with the results. In our demonstration case, the workflow outlined in this presentation began on a Tuesday afternoon, with internal laser scanning performed Wednesday mid-day and preliminary results available to the client by Thursday afternoon. The accelerated results achieved through this process enabled the operator to avoid unnecessary repairs (and the delays that accompany such work).

Evaluation of Laminations and Flaws in Equipment in H_2S Service – Brian Mecejko and Ryan Jones, Equity Engineering?

Part 13 of API 579-1/ASME FFS-1 Fitness-For-Service (API-579) details the inspection requirements and evaluation techniques for Assessment of Laminations. It is very common for carbon steel manufactured prior to the 1950's, 1960's, and 1970's to have laminations and inclusions. Without destructive testing or a baseline ultrasonic examination (UT) inspection, it is nearly impossible to decipher whether laminar indications in plate material have been present since original construction or whether they have been caused by hydrogen diffusion during operation. API-579 therefore requires that multiple levels of relatively closely spaced laminations in a hydrogen charging environment must be treated as Hydrogen Induced Cracking (HIC) and therefore evaluated using Part 7 Assessment of Hydrogen Blisters and Hydrogen Damage Associated with HIC and SOHIC. The Part 7 procedures consider the potential for failure due to loss of material strength as well as brittle fracture. Even if the damage is concluded to be completely laminar without evidence of through-thickness directional cracking or linkage between laminations, there is no guidance provided in the API-579 document to justify reduction of the conservative assumptions on material strength and fracture toughness that are typically used to evaluate HIC (and SOHIC) damage. Subsequently, many assets fail the Fitness-For-Service evaluation procedures. A recent case history involving evaluation of laminated plate removed from a hydrogen charging environment will be presented. The presentation will include results from field and laboratory non-destructive examination (NDE) techniques as well as destructive material testing.

New ASME Program for Training and Qualification of Bolted Flange Joint Assemblers – C. Rodery, BP

A revised Appendix A of ASME PCC-1 has recently been approved and will be published in the near future. This Appendix was developed in response to a need expressed by some in the bolting services industry. It provides guidelines for establishing uniform criteria for training and qualifying bolted joint assembly personnel. It also provides guidelines for quality control of the program. This presentation will provide an overview of the key highlights of the Appendix, including the various qualifications that are available, the related experience requirements, the fundamental training areas associated with each qualification, an examination overview, maintenance of qualifications, and ongoing quality assurance of the program.

Inspection/NDE Track:

Morning Session 1:

In-Service Inspection of Stainless Steel Heat Exchanger Tube with Eddy Current Array Probe- M. Grenier and J.R. Konerza, Eddify and J.R. Konerza, Sentinel Integrity

Eddy Current Testing (ECT) is a commonly used technique to inspect non ferromagnetic heat exchanger and condenser tubing. The typical bobbin probe configuration has proven to be efficient to detecting volumetric flaws such as pitting, fretting, erosion and general corrosion. To some extent, it is even possible to perform sizing with this probe / coil configuration as long as the calibration standard represents the damage mechanism found in the tubes to be inspected. However, this probe design faces two major limitations, the first limitation is when the defect mechanism is related to cracking, especially along the circumferential axis of the tube, the second limitation is the ability to determine circumferential extent for larger volume flaws. Motorized Rotating Pancake Coil (MRPC) probes have been developed to overcome the limitation of the circumferential cracking and to provide a high resolution mapping of the tube, sensitive to all type of flaws in any orientation. However, this inspection technique remains very slow and not appropriate to inspect the entire tube length. Eddy Current Array (ECA) probes have been introduced with some success for Steam Generator inspections, but these probes are very specialized and cost prohibitive outside the scope of SG applications. Other specialized bobbin probes also labeled as array probes integrate a dedicated coil assembly to detect the circumferential cracking are available, but the sensitivity is generally not uniform around the circumference and the sizing capability remains very limited. Another alternative to MRPC, SG Probes, and specialized bobbin probe is to use Eddy Current Array (ECA) probes that utilizes channel multiplexing. The ECA probe integrates several individual surface sensor coils into the probe which are channel multiplexed to improve the resolution, the detection capability and the sizing of defects while maintaining high speed inspection of the entire length of the tube. This paper provides an overview of the operating principles and the capabilities of a new configuration of ECA probe that combine a high resolution array sensitive to circumferential defect and a regular bobbin probe. Laboratory and field results are presented and compared to normal and specialized bobbin probe response. The effect of the tube sheet and tube support plate on the signal quality and defect detectability is also discussed.

Near Field Testing: New Developments and a Case Study - Tim Rush, Mistras Group
This paper addresses Near Field Testing (NFT), which was introduced in the Oil and Gas industry approximately 10 years ago for the inspection of air cooler tubes (Fin Fans). This technology has proven to be a cost saving alternative over other inspection methods, such as IRIS and MFL (Magnetic Flux leakage). By illustrating examples of field cases, data graphics, etc., the presentation will show the advancements of the

technology and how it has become a preferred tubing application for the detection of internal corrosion, pitting, and inlet erosion.

Inspection of Insulated Components by Pulsed Eddy Current for CUI & High Temperature Damage- Tom Burnett, Intertek/Apteck

Industry experience with the catastrophic failure of piping, feedwater heater shells, high pressure feedwater lines, auxiliary steam systems and other miscellaneous piping systems fortify the mandate to locate, inspect, and classify the degree of corrosion under insulation, flow accelerated corrosion and other wall loss damage common to these systems. Most inspections are typically a balance between intrusive offline and non-intrusive, on-stream methodologies. Numerous current state-of-the-art inspection methodologies are being applied in plants to measure wall thickness such as: ultrasonic testing (UTTH), radiography (RT) and Pulsed Eddy Current (PEC) for this purpose. Non-intrusive, on-stream inspection of equipment in high temperature service because of the presence of insulation is particularly challenging. Significant improvements have been made to the PEC technologies for this purpose, as well as for additional applications in industry. This presentation is meant to provide information on the improvements and application of current technology for high temperature wall loss as well as common problems and restrictions associated with methodologies.

Eddy Current Arrays as a Replacement of Traditional NDT Methods for Detection of Surface Breaking Cracks - Tommy Bourgelas, Olympus NDT

Multiple Eddy Current Sensors placed in close proximity to form an "Array" provides large surface area inspection rapidly. This technology provides a "C Scan Image" of the area inspected therefore recording and documenting the inspection. Eddy Current Arrays rely on magnetic field coupling, which provides fast inspection through coatings such as paint. Rapid coverage, high sensitivity and probability of detection excels over traditional NDT methods such as Penetrant and Magnetic Particle. This presentation will detail the fundamentals of Eddy Current Testing, the latest Technology in Eddy Current Array and exemplify applications through illustrations and photographs

Speeding Up Your Inspections with Eddy Current Arrays - Dana Ives and Bobby Kennedy, Mistras Group

Over the years, probe technology and data processing have advanced to the point where Eddy Current Testing is recognized as being fast, simple, and accurate. The technology is now widely used in the petrochemical, aerospace, automotive, and power generation industries for the detection of surface or near-surface defects in materials such as aluminum, stainless steel, copper, titanium, brass, Inconel®, and even carbon steel (surface defects only). With the advancements in probe design and multiplexing, Array Eddy Current drastically reduces inspection time and covers large

areas with a single pass. It also provides real-time cartography of the inspection area which asset greatly in the data interpretation and improves reliability and probability of detection (POD). A brief discussion will be presented regarding application array eddy current for stress corrosion cracking (SCC), Hydrogen induced cracking (HIC), and permeability variations in duplex piping.

Morning Session 2:

Active Corrosion Monitoring with AET – Successful Case Studies - Miguel A. González Núñez, Jean-Claude Lenain, Alain Proust, Valery Godinez, Mistras Group
Short periodic in-service monitoring with a specialized Acoustic Emission (AE) system started with CORPAC™ and now Pocket CORPAC™ and proprietary software, provides early detection of "ACTIVE" corrosion in such industrial structures as process equipment, vessels, tanks and piping, all whether carbon or stainless steel. The general CORPAC™ technology has been developed in Europe over the past fifteen plus years with MISTRAS Group (Euro-Physical Acoustics, French subsidiary) Rodhia, Solvay and INSA Lyon starting with a European Seed Grant. For the past 20 years MISTRAS Group has reported the successful in-service corrosion monitoring of above ground tanks utilizing its proprietary TankPAC™ acoustic emission expert system technology package. More than 10,000 tanks have been tested repeatedly worldwide and especially in Europe. In practice the AE detection used for above ground storage tank inspection are rarely suitable for in-service monitoring of active corrosion and frequencies 5 times higher need to be used in process environments in order to avoid strong background noises created by the processes. In-turn, one consequence of the use of higher frequencies for active corrosion monitoring is that the distance at which AE sources can be detected is limited to typically one meter distance from the sensor. The ability to identify when corrosion is active is very useful and in many ways. For example, CORPAC™ technology can be used to help corrosion control inhibitors to be added when corrosion is detected to be active. Specifically, for a recent application where de AE activity rate of 100,000 emissions per hour was reduced to less than 200 emissions per hour when the customer added to the vessel inhibitors. The CORPAC™ "expert" system checks background noise, runs the test for one hour duration, and advices the operator if localized active corrosion (pitting or stress corrosion cracking) is present or not. Where it is desired to monitor a larger area or many areas at the same time, multi-channel AE systems are used to acquire the data and then the CORPAC™ "expert" system is applied for analysis. Detection of corrosion by acoustic emission is not a new phenomenon, the first papers being published in the early 80's. However, years of experience and continuing development have helped to make the use of the method practical and in some cases even quantitative. Recognizing and eliminating noise is still the main challenge due to the small size of the signals in the presence of potential

process noise. Modern instrumentation, pattern recognition and neural networks have helped to develop the new "Pocket CORPAC™" system with enhanced capabilities and easy to use by non-expert operators. Our presentation will include 5 – 6 field case studies where we will show the technology's effectiveness while pointing out any pitfalls. Additionally, we will present successful statistics of its use for the past 15 years or so.

Utilizing AE Monitoring for Damage Mechanisms in FCC Fractionator Tower to Provide for On-going FFS Confirmation – Steven Garcia and Claudio Allevato, Stress Engineering

This presentation will be about an FCC Fractionator tower, which was found to contain several cracks on the ID, about 9 years ago. Most of them were removed by gringing and weld overlay applied. At the bottom of the tower, several cracks were left due to different reasons such as access, coatings, time constraints, etc. Management decided to use AET to "monitor" the bottom two cans of the tower using a series of in-service pressurizations to 110% of the tower's previous pressure within last 12 months. This is according to ASME Sec V, Article 12.This series of AET monitorings revealed mild progression of previously known flaws, and allowed them to bring the tower to the present T/A

A Review of Acoustic Emission Testing for Leak Detection in Aboveground Storage Tanks - Ronnie K. Miller, Mistras Group

Acoustic Emission (AE) is commonly used to assess the condition of aboveground storage tank (AST) bottoms without removing the tanks from service. This is attractive to owners and operators as they are not required to empty or decontaminate the tank in order to perform the AE test. The results of the test are used to prioritize tanks for internal inspection based on the amount of active corrosion detected. This presentation will focus on those situations where the AE data from active corrosion does not warrant internal inspection but the presence, or suspected presence, of a leak does.

AET Surveillance of a Nozzle Flaw in a Process Column - Glenn A. Aucoin, Stress Engineering

This presentation will explain the application of AE as a method which provided an operator the feedback required to safely continue operation of a vessel with a through wall flaw. AE when used as a surveillance method can provide equipment owners valuable feedback to make decisions on continuing operation of damaged equipment. A vessel operator witnessed product leaking through the weep hole of a nozzle repad. This vessel was operating at 750F in a continuous process and the next shut down opportunity was not scheduled for another two years. The proximity of the flaw and

the surface temperature of the vessel precluded the application of conventional NDE methods for characterizing the flaw. The owner required a method to ensure that this flaw was not detrimental to the integrity of the vessel in its current state, and that the severity of the flaw did not become significant during daily operations over a 2 year period. Continuous monitoring of the nozzle using AE and an internet interface allowed for continuous and immediate feedback when activity alarm conditions were met. The location algorithm of the AE software established the source locations as well as screening of external signals. User defined ratios of the AE hit features allowed characterization of the source signals and allowed for concluding that the majority of the AE activity was generated from mechanical signals as opposed to crack-like signals. The intended audience of this presentation includes owners/operators/inspectors of equipment which could experience cracking as a damage mechanism and who may desire to continue operation of any equipment in a damaged condition.

Afternoon Session 1:

What You Should Know Before You Replace or Upgrade Your Inspection Information Management System – Mark Bell, Shell Global Solutions (retired)
The foundation of any quality equipment integrity management system is the inspection information management tool. To be effective, these tools must be comprehensive, user-friendly and provide transparency of information. Not only must these tools provide the functionality to store data, they must also: Accommodate multiple forms of information analysis, interface with associated management systems, such a maintenance management systems and operation unit process data systems, RBI systems, etc. and provide clear reporting to all stakeholders with an interest in integrity Management. This discussion will outline the necessary and desirable components of an effective inspection information management system. It will emphasize the need to keep the functionality of such tools effective and uncomplicated.

The Importance of Quality Data in a Modern Day Inspection Department – Mark Vining, Intertek AIM
The presentation will speak to the changes that are often faced by an inspection department when dealing with internal/external auditors and regulatory bodies. The document will attempt to explain the transition these departments are experiencing as a result of traditional inspection methods not always proving capable of providing asset integrity related data in an accurate, timely and organized manner. In addition, the presentation will speak to the value of using properly designed, implemented, populated and managed Inspection Data Management Systems (IDMS) to become more proactive specific to damage prediction and mitigation. The presentation will

address the speaker's proposed roles and responsibilities of IDMS caretakers ranging from data clerks to department managers in the hope that the listeners will remain engaged no matter what their current levels of involvement. Previous talks and presentations regarding this subject have demonstrated that the proposed topic has generated strong opinions and discussions related to how varying organizations manage said data and their IDMS implementation techniques.

Implementation of a Corporate-Wide Mechanical Integrity Inspection Data Program at Flint Hills Resources – Scott White, FHR and Vinay Nihalani, Meridium

Flint Hills Resources (FHR) embarked on a project to implement an Enterprise System for its corporate Mechanical Integrity (MI) Program several years ago. After evaluating different options, FHR selected an Asset Performance Management (APM) system based on the following major considerations.

- The new system must support multiple sites and existing MI work process and help ensure statutory compliance for many types of federal, state, and local regulations.
- The new system must support tracking and closure of many different types of data elements for Inspection Tasks and Field Events, Inspection Recommendation, etc.
- The new system must integrate with an:
  - Existing plant CMMS providing integration of Maintenance and Inspection Work Processes.
  - Existing API RBI Calculator software providing a direct connection between Inspection Planning and Risk Calculation.
- The new enterprise system must eliminate "islands of information" that existed among the FHR sites.
- The new system must provide ease of use for end-users while providing the necessary complexities for querying, reporting, alerting, and auditing required for extensive data management.

This presentation outlines the strategic approach adopted by FHR for our MI project which extended well beyond just positioning the project as an IT Implementation. Throughout the project, FHR has focused on all three elements needed for ensuring success – ***Process, People,*** and ***Technology***.

Process: MI processes and procedures have been standardized and Metrics as well as other monitoring tools have been put in place to ensure that these processes and procedures are followed consistently across all FHR sites.

People: In addition to training for our workforce, FHR has developed the tools, monitoring controls and stewardship programs to promote the right culture needed to keep the program sustainable.

Technology: Last but not the least, software tools are being implemented at FHR's sites to enable the MI Processes and empower users with the right tools, so they can make the right decisions at the right time.

Corrosion Measurement Data - Getting the Most out of Your CMLs - Dave McFarland, Shell Oil Company

Dave McFarland will explore rules of thumb to apply for collecting corrosion measurement data. He will also address how to manage the data especially measurement "outliers" and "growths." Managing this data more effectively leads to better quality data and subsequently technical decisions for the assets you manage.

Afternoon Session 2:

Three Dimensional Laser Scanning of Aboveground Storage Tanks - Idamarie Carden, Petrochem Inspection Services

The application of Three Dimensional Laser Scanning of Tanks provides Owner/Operators a great deal more information regarding their Tanks. This presentation will discuss the information that can be obtained by deploying this technology. This technology can provide detailed assessment of the shell of the tank with regard for deformations. The information collected can provide an "as is" detailed digital representation of any deformations present. The same assessment of the shell can be applied to the bottom allowing a thorough assessment of Tank Shell and Bottom Settlement allowing for the worst area of deflection to be identified based on the vast number of elevations collected from the bottom. With the inspection map created of the bottom, the entire affected area can be identified for the area and the profile of the bottom to allow for a more accurate Finite Element Analysis of the area. Tank Calibration is another area where the technology can be utilized. Utilizing this technology for Tank Calibrations can ensure that volumes are derived utilizing the full surface of the Tank Shell and Bottom to include all deformations are included in the computations.

Advanced On-stream Inspection Topics for Atmospheric Storage Tank Bottoms - Joe Krynicki, Exxonmobil

This presentation will address various aspects of tank bottom reliability and inspection including: corrosion concerns, Risk Based Inspection considerations, and, on-stream

inspection technologies and challenges. Much of this presentation will focus on tank bottom and critical zone corrosion concerns and the status of relevant on-stream inspection technologies.

Small Tank Inspections per STI SP001 5th Edition- Dana Schmidt, Steel Tank Institute
The standard SP001, first issued in 2001, addresses tanks and containers not covered by other industry standards for inspection. The 5th Edition of this Standard was issued in September 2011. The standard includes requirements for tanks and containers from 55 gallons to 265,000 gallons and inspection guidelines for portable containers, single and double wall tanks, horizontal, vertical and rectangular tanks. The audience will gain a better understanding of the risk-based inspection criteria of SP001. Included in the presentation will be a comparison of the 5th Edition of the Standard to previous editions. Although I spoke on this subject at the last API Inspector Summit, this revised edition was issued after the Summit and thus contains new information. The presentation is intended for tank owners, tank inspectors and tank regulators. Numerous photos help to express the applicability of the standard to many varied tank installations.

Risk Based Inspection of Storage Tanks- Jesus Esquivel, CUASMEX Services
The presentation will discuss the elements in probability, consequence of failure and Risk, as well as real applications describing the inspection planning and benefits for quantitative RBI Storage Tanks. Also, provide a guide to use code requirements, methods of analysis and best practices. Topic relevant to the industry. There are over 700,000 aboveground storage tanks in the U.S. with capacities ranging from 500 barrels to over 500,000 barrels. Many of these tanks leaks requiring repair. Risk based Inspection is the most important methodology to established damage mechanisms, probability and consequence of failure and control the actual and future risk.

Materials/Corrosion Track:

Morning Session:

Minimizing CUI with Thermal Sprayed Aluminum Coatings - Howard Mitschke, Coatings Consultant (previously w/Shell Global Solutions).
Although thermal spray aluminum (TSA) technology has been around for decades, its use began to expand in the last 15 years. One of its primary uses is as a corrosion protective coating under thermal insulation (CUI). In this presentation, a brief history of its use and application methods are reviewed. What are the reasons for owners specifying it more and more? What are the advantages and limitations of TSA? What are some of the difficulties experienced in the field with applications? Finally, what does the coating inspector look for to ensure optimum applications?

Maximizing the Service Life of Refractory Linings with the Right QA/QC – Chris Fowler, ExxonMobil

In November of 2008, The American Petroleum Institute adopted API Standard 936 – Refractory Installation Quality Control – Inspection and Testing Monolithic Refractory Linings and Materials. This standard represents an industry consensus of the minimum requirements for Quality Control and Quality Assurance for the installation of monolithic refractory products, and provides guidance to establish quality control elements to achieve defined requirements. The role of the API-936 practitioner in insuring compliance with this standard is discussed. Future plans for API 936 include:

- Continued expansion of program and certification to include multiple languages.
- Incorporate content from API 560 and any other new standards which include refractory technology.
- Development of an on-line recertification test to keep practitioners current with changing technology.
- Defining experience expectations for entry, mid-career and senior refractory inspectors.

The Key to Getting the Maximum Service Life from Your Plant Coatings - Monica Chauviere, Monicorr, Inc.

The oil and gas industry has been plagued for some 30 years with corrosion damage caused by Corrosion Under Insulation (CUI). Most corrosion professionals understand the phenomena. Water ingress into insulation systems is held for long periods against the warm or hot steel by the relatively thick, water-absorbent insulation, causing corrosion of unprotected carbon steel, or upon steel that was never coated with a proper immersion-grade coating. Over the years since Corrosion Under Insulation (CUI) became an "industry-famous" acronym, there have been many studies, articles and research efforts directed at the improvement of coatings technology to help combat that chronic and very expensive issue. There has been substantial progress made with industrial coatings technology in the past 2 decades. The industry has gleaned much benefit from field experience and laboratory R&D. There is still, however, one factor that must be recognized as applicable to the real world. . . .and that is that there is no such thing as a perfect shop- or field-applied industrial coating. In spite of state of the art technology, providing excellent performance in the protection of steel in hot, wet conditions, it must be recognized that there is no such thing as a "silver bullet" which provides complete protection of all surfaces on all equipment. Coating application conditions are not perfect and people are not perfect; yet it is people who are employed to select and install CUI coatings in real world conditions. Thus, there is need to recognize other factors that impact the risk of CUI. This presentation addresses

parameters and characteristics related to industrial insulation which are influential on both the risk of CUI and the thermal functionality of the insulation. Both of these factors have significant bearing on the cost to own and operate a facility.

Reliable Corrosion Rate Measuring Techniques – Sam Lordo, Nalco Energy Services Division

Corrosion monitoring takes many forms in Industry, varying from absolute measurements to inferred measurements. In addition new methods are being developed to try and move closer to real time corrosion monitoring. This presentation will look at some of the more commonly used methods used in Refinery settings by chemical suppliers. Also discussed will be some of the newer methods that have been developed and that begin to move corrosion monitoring to near real time. Data collected by chemical suppliers has traditionally been used and evaluated by the Process/Operations groups. However, this corrosion data accumulated by chemical suppliers can be a vital part to quantifying and monitoring equipment condition

Afternoon Session:

Improving Your Failure Analysis Process to Prevent Future Failures - Steve Burkle, Lloyd's Registry

Failure analysis is an essential tool for mitigating repetitive mechanical, metallurgical, and corrosion-related failures in process equipment in all segments of the Oil & Gas and Petrochemical Industry. When the results of a failure analysis are combined with inspection methods such as nondestructive examination, damage already present in equipment can be proactively pinpointed and detected before breech of containment occurs. Failures in welds, wrought products, and castings can be eliminated by understanding the cause of failure and by applying effective methods of repair or by changing the material composition. A failure analysis can only be effective if adequate and accurate failure data is available, and if the physical sample of the failure is removed, labeled, sectioned and processed correctly. This paper describes the failure analysis process, including the specific types of design, process, and inspection data needed to assess a failure, various methods used for failure analysis, and proper specimen selection and sampling. Actual case studies will be presented.

Leaks in Duplex SS Tubes from Aggressive MIC – Art Jensen, Delaware City Refining (PBF Energy)

The Delaware City Refinery has experienced severe Microbiologically Induced Corrosion (MIC) in brackish river water cooling exchangers. The problem has resulted in through-wall tube leaks, severe crevice corrosion to the tube sheets (gasket surfaces and tube roll areas), and corrosion in the floating head (gasket surface through-wall leaks). The

affected metallurgy has been Duplex 2205 and 2507, which the refinery has been using for this service since approximately 2006. This presentation will discuss what has been learned through the investigation which has taken many paths. Factors to be discussed include: MIC-resistant metallurgy (including the importance of PREN calculations for varying alloy content in Duplex); river-water chemistry and composition changes over years and seasons; water biocide treatment options and limitations; inspection methods being used to detect pitting on the ID of the tubes; and repair methods that have been tried to mitigate the corrosion and extend bundle life.

NASA Insulation Technology for Improving CUI Resistance – Monica Chauviere, Monicorr, Inc. (previously ExxonMobil)

The oil and gas industry has been plagued for some 30 years with corrosion damage caused by Corrosion Under Insulation (CUI). Most corrosion professionals understand the phenomena. Water ingress into insulation systems is held for long periods against the warm or hot steel by the relatively thick, water-absorbent insulation, causing corrosion of unprotected carbon steel, or upon steel that was never coated with a proper immersion-grade coating. Over the years since Corrosion Under Insulation (CUI) became an "industry-famous" acronym, there have been many studies, articles and research efforts directed at the improvement of coatings technology to help combat that chronic and very expensive issue. There has been substantial progress made with industrial coatings technology in the past 2 decades. The industry has gleaned much benefit from field experience and laboratory R&D. There is still, however, one factor that must be recognized as applicable to the real world. . . .and that is that there is no such thing as a perfect shop- or field-applied industrial coating. In spite of state of the art technology, providing excellent performance in the protection of steel in hot, wet conditions, it must be recognized that there is no such thing as a "silver bullet" which provides complete protection of all surfaces on all equipment. Coating application conditions are not perfect and people are not perfect; yet it is people who are employed to select and install CUI coatings in real world conditions. Thus, there is need to recognize other factors that impact the risk of CUI. This presentation addresses parameters and characteristics related to industrial insulation which are influential on both the risk of CUI and the thermal functionality of the insulation. Both of these factors have significant bearing on the cost to own and operate a facility.

Inspection of Injection Point Internal Hardware: quills, spargers, spray nozzles, etc. – Kimberly Comeaux, Coffyville Resources (CVR) and Sam Lordo, Nalco

Injection systems are designed to modify a process stream, or to control chemical/physical interactions of specific process streams. Typically we rely on corrosion related injections for quenching, scrubbing, neutralizing/corrosion inhibition.

Since the flow rate of the injected fluid is just a small fraction of the mixed stream, we typically overlook the injection hardware itself, and focus on the adjacent piping. However, the designed mixing system must be functioning at its optimum in order for it to do its job and provide the intended corrosion related duties. Therefore, inspection of the injection hardware is essential to the proper performance. Common configurations include simple tees, quills, spray nozzles and spargers to disperse the injecting stream.

This presentation will focus on the inspection requirements of the injection hardware including corrosion, erosion and fouling effects.