BIOGRAPHICAL INFORMATION

Renee Gonzales

Pipeline Integrity Engineer

Valero Logistics Operations, L.P.

Specific Responsibilities

Joined Valero Logistics Operations, L.P. in 2003

Responsible for performing risk analysis on Valero's DOT and TRRC pipelines, assisting in determining the appropriate preventive and mitigative measures for pipeline systems, and preparing cost estimates and appropriation for Authorization for Expenditures (AFEs) on capital projects such as pipeline replacements

Past Experience

Valero Logistics Operations, L.P. – Pipeline Integrity Engineer – San Antonio, TX – 2003

- Uses a risk management program to perform a risk analysis on Valero’s DOT and TRRC pipeline systems
- Imports data from Valero’s GIS system (ValGIS)
- Utilizes the results of the risk analysis to help determine the types of preventative and mitigative actions Valero can perform to keep its pipeline systems within regulations
- Prepares cost estimates and appropriations for AFEs on pipeline capital projects such as pipeline replacements
- Uses SAP to generate requisitions, work orders, and receiving services
- Works with vendor to create web versions of operating forms

Valero Logistics Operations L.P. – Contract Associate Mechanical Engineer – San Antonio, TX – 2003

- Prepared and submitted AFEs for capital
- Designed, specified, and procured materials and equipment for projects
- Prepared schedules for approved projects

- Provide engineering expertise to management regarding project and operational needs

City Public Service – Summer Engineering Intern – San Antonio, TX – 2002

- Utilized planning and time management skills to attain goals and schedules
- Prepared, read, analyzed and interpreted layouts for renovation along with layout for HVAC using modeling software such as MicroStation
- Effectively presented information to upper management by preparing written and visual justification for certain projects
- Developed an understanding of projects assigned by obtaining data on the performance of products through interacting with personnel at all levels

City Public Service – Summer Engineering Intern – San Antonio, TX – 2001

- Used project management skills by organizing, selecting vendors and distributing responsibilities for certain projects
- Organized project planning, budgeting and coordination
- Assisted in collecting data and defining problem in order to produce graphical information in production

Educational Information

B.S. – Mechanical Engineering, University of Texas at San Antonio

Professional Memberships

Member of American Society of Mechanical Engineers (ASME)

Member of American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

EVALUATING RISK SOLUTIONS FOR PIPELINE INTEGRITY MANAGEMENT

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ABSTRACT

Investigating risk analysis of pipelines is a major factor of gauging the integrity and condition of a company's pipeline system. Exporting data from a GIS database through software views and importing that data into Integrity Management Program (IMP) software helps maintain consistency and conform to federal regulations. Once the IMP software has the correct data, operators perform an evaluation of the risk factors by determining how the likelihood of failure and the consequence of failure could affect an HCA. By performing a drill down of these factors, the operator identifies the comparison criteria (CC), which categorizes the most important risk drivers for the highest risk locations and the underlying causes of that risk. The CC is determined by where either the sections exceed two standard deviations from the statistical mean of a normal distribution of risk scores or the areas containing risk within the top ten percent of each threat if it does not follow that distribution. Using the results from the CC, the operator determines measures to prevent and mitigate the consequence of a pipeline failure that could affect an HCA, including conducting analysis of the pipeline to identify additional actions that will enhance public safety or environmental protection.

INTRODUCTION

Valero Logistics Operations (Valero or the Company) uses a formalized risk analysis program to evaluate the integrity of each pipeline segment as part of the ongoing continual evaluation process. This program ensures that the Company analyzes all available information about the integrity of the entire pipeline and the consequences of a failure as well as assures that the Company conforms to federal regulations.

The IMP software contains over 200 standard variables with the ability to incorporate an unlimited number of user-defined variables and utilizes dynamic segmentation. Dynamic segmentation allows Valero to input and evaluate all the risk factors independently of each other. This technique collects all the risk data and creates a risk score every time a risk variable changes, thus creating many segments within a segment. This technology prevents the user from having to use the worst-case value for variables uniformly across the High Consequence Area (HCA) segment.

In addition, the IMP 6 software can manage data in both linear and temporal dimensions. Linear data from various sources can have various reference points or stationing equations. Some data sources may refer to mileposts or pipeline stationing along the pipe, whereas ILI data may be stored as a wheel count. Even when data uses the same reference scheme, pipe lengths are usually different from data source to data source. IMP 6 brings together all of these references to establish linear aspects of the pipeline; then, it not only performs an analysis on any section of pipe, but it also can further refine any selected time period.

With these added capabilities, the IMP Engineer can place a greatly refined emphasis on the risk factors used to analyze the HCA pipelines and facilities. This emphasis allows Valero to more effectively

- pinpoint pipeline locations having the highest estimated risk
- identify most important risk drivers for the highest risk locations
- identify underlying causes of primary risk drivers, which will lead to possible mitigative/preventive actions
- track the reduction of risk with time

The scenario features of the program give Valero a formalized tool to determine economically feasible preventive and mitigative actions that result in the highest reduction of risk.

EXPORTING DATA FROM GIS TO IMP SOFTWARE – DATA INTEGRATION

The IMP Engineer extracts adequate and appropriate data (e.g., report data and design and physical data) from Valero's pipeline GIS database system (ValGIS). ValGIS is an enhanced form of the Pipeline Open Data Standard (PODS) database and a centralized storage location for information on the following:

- HCAs and Could Affects
- Pipeline Design
- Cathodic Protection and Corrosion
- Internal Corrosion and Inhibitors
- In-Line Inspection
- Pressure Testing
- Pipeline Repairs

The IMP Engineer integrates information from ValGIS and pertinent information taken from Valero's Subject Matter Experts (SMEs) into IMP 6 to perform an effective risk analysis.

<u>Report Data</u>

Valero uses numerous reports to collect data and ensure that IMP 6 receives consistent information for different segments from ValGIS. These reports include, but are not limited to, the following:

- Pipeline Information Reports/Defect Evaluations Forms
- Leak Reports
- Pipeline Aerial/Surface Reports
- Hydrostatic Reports
- In-line Inspection (ILI) Reports
- Atmospheric Report
- Internal Corrosion Coupon Report
- Interview Data Sheet*****

***NOTE:** The IMP Engineer distributes the Interview Data Sheet, which documents the process of gathering subjective information, to all of Valero's field operation personnel who are best suited for gathering subjective information within its pipeline system.

<u>Design and Physical Data</u>

Most design and physical data originate from the following sources:

- Alignment Sheets
- SAP
- CPDM
- One-Call Records
- STASGO Data Base (USDA)

NOTE: Using the data collection avoids best-estimate risk evaluation.

EXPORTING DATA FROM GIS TO IMP SOFTWARE – DEVELOPING VIEWS FOR DATA IMPORT

To perform a risk analysis in IMP 6, the IMP Engineer exports the data from the GIS system and imports the data into IMP 6. The view, which is a customized data export from the PODS database of events, is then exported into the models of IMP 6. A view is created for each model in IMP 6. These Views will return the latest data from the GIS database in a 1 to 1 variable mapping to the IMP input model. This action allows the view to match exactly with the IMP metadata format. The 1 to 1 mapping also allows for IMP 6 to use these models to hit the GIS database and import the latest data without having to re-map the variables.

EXAMPLE: In ValGIS, the view named "Pipe Design" shows the diameter, wall thickness, SMYS, and grade information. This information will be populated or mapped into the IMP 6 diameter, wall thickness, and SMYS models. If the view and the models do not match up precisely, the data will not be exported from GIS into IMP.

Valero bases the collected data on the requirements identified in the Risk Assessment Algorithm and extracts most of the data requirements from ValGIS, which provides completeness and quality of input information through a customized import wizard.

PROGRAM CUSTOMIZATION – ALGORITHM

Valero developed its Risk Assessment Algorithm for the IMP 6 program based on failure frequency history, Subject Matter Exports (SMEs), industry statistics, and benchmarking studies. When justifying the magnitude of any numerical weight used to estimate measures of risk, IMP Engineers and SMEs met with the vendor's Project Manager to determine the weights for each variable within the threat index and the consequences index, based on their knowledge (shown in Table 1: SME's Area of Expertise).

Table 1: SME's Area of Expertise

Corrosion	HSE	Special Projects
♦ External Corrosion ♦ Internal Corrosion ♦ Outside Forces ♦ SCC	♦ Third Party	♦ Manufacturing ♦ Equipment ♦ Construction

Since the Company's goal for the algorithm development process was to ensure that the threat and consequence assessment models reflected its views of risk and pipeline systems, Valero places importance on continuously revisiting and modifying the weights whenever evidence shows that adjustments are appropriate. Valero uses the Risk Assessment Algorithm to measure the magnitude of risk for attributes within the threat and consequence indexes to a pipeline system. However, before an algorithm can be defined, a variable template needs to be created using the variables contained in the Likelihood of Failure and Consequence of Failure components.

Likelihood of Failure

When assigning threat variable weights to Valero's pipeline systems, the SMEs and IMP Engineers examined all nine threat types and considered the environment of its pipelines, past failures of its pipelines, and the causes of past incidents.

The Likelihood of Failure (LOF) threats are grouped into nine threat type categories, which are as follows:
- Third-Party Damage (TP)
- External Corrosion (EC)
- Equipment (EQ)
- Incorrect Operations (IO)
- Construction (CONS)
- Manufacturing (MFG)
- Internal Corrosion (IC)
- Weather and Outside Forces (WOF)
- Stress Corrosion Cracking (SCC) (*IMP Training Manual* 2005)

The IMP Engineer and SMEs determine the percentage assigned to each threat category, which totals 100%. (*IMP Training Manual* 2005)

Consequence of Failure

After assigning each threat type category a weight, Valero assigned each of the three impact types a weight. Each impact type is a unique collection of variables that individually describe the effect of an unintentional pipeline release.

When assigning consequences variable weights to Valero's pipeline systems, the SMEs and IMP Engineers examined all three impact types and used some of the following considerations:

- Pipeline surroundings
- Product characteristics
- Pipeline operating conditions
- Property damage
- Human injuries
- Environment damages
- Total consequence expressed in dollars

The Consequence of Failure (COF) score, also called the leak impact factor, includes acute as well as chronic hazards associated with product releases. Valero grouped the COF impacts into the following three impact type categories:

- Impact on Population (IOP)
- Impact on environment (IOE)
- Impact on Business (IOB) (*IMP Training Manual* 2005)

The final results of the weights of the impact types must total 100%. (*IMP Training Manual* 2005)

PROGRAM CUSTOMIZATION – VARIABLES

Each LOF and COF is made up of assorted variables that are pertinent to risk and consequence. The variable template is a list of variables that potentially could cause risk to an HCA pipeline system. The variable template serves as a starting point from which key variables are selected from a risk or consequence standpoint to perform a risk analysis. (*IMP Training Manual* 2005)

IMP 6 allows the use of one variable for multiple threats types; however, the key to proper risk analysis is to be sure that the meaning of a variable is unique each time it is used. (*IMP Training Manual* 2005)

EXAMPLE: When considering the threat type external corrosion and the variable soil type, the attribute rocky soil around a pipe could potentially damage the coating and impair CP distribution, and rocky soil is generally perceived to increase risk. In contrast, when considering the threat type weather and outside forces and the variable soil type, the attribute rocky soil around a pipe reduces the likelihood of movement and reduces risk.

By considering each variable in each index, the IMP Engineer arrives at a numerical value for that index and then sums the 12 index values to a total value called the index sum representing the overall failure probability for the segment evaluated. That sum should always equal 100%. (*IMP Training Manual* 2005)

PROGRAM CUSTOMIZATION – ATTRIBUTES

Within each variable, attributes contain specific characteristics that have a direct connection to the class type of a variable. (*IMP Training Manual* 2005)

After assigning each variable a weighting, the IMP Engineer assigns each attribute for that variable a score. Attributes reflect the environmental characteristics of the pipeline that are difficult or impossible to change. There are characteristics over which the IMP Engineer usually has little or no control. The attribute is scored based on a scale such as that shown in Table 2: Weightings for Conditions/Threats. (*IMP Training Manual* 2005)

Table 2: Weightings for Conditions/Threats

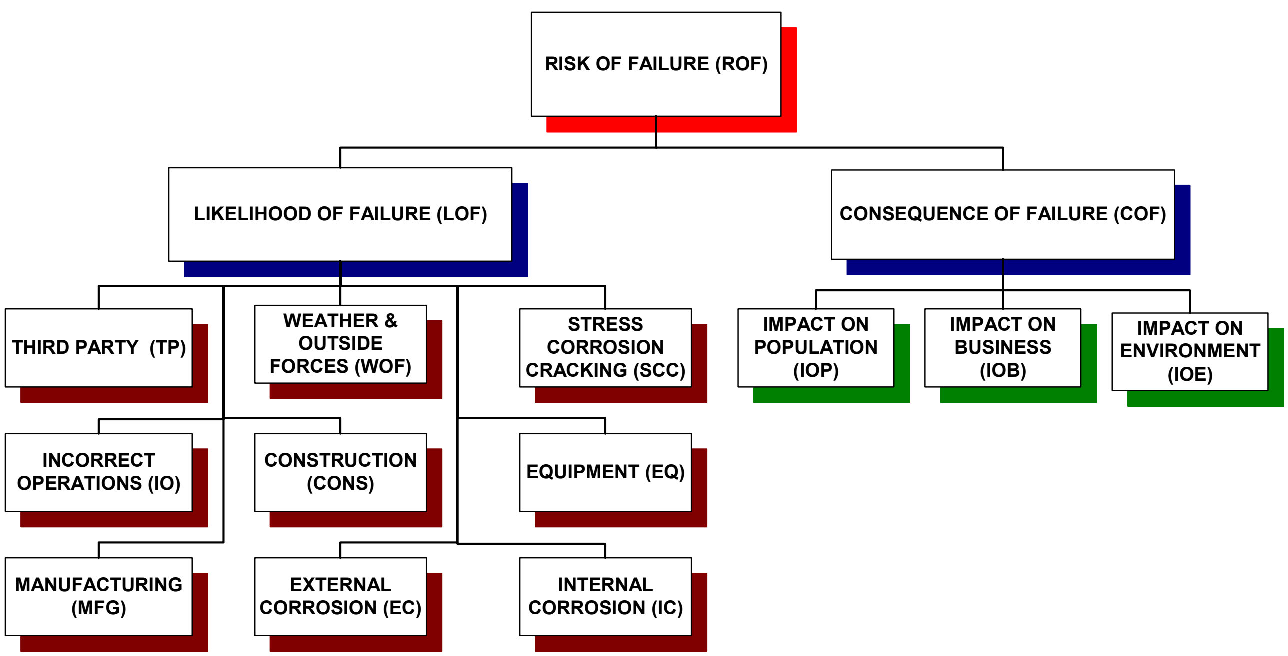
Weighting	Conditions/Threats
10 9	Attribute can easily, independently contribute to threat – **Highest Weight**.
8 7	Attribute can possibly, independently contribute to threat.
6 5	Attribute is a significant contributor to threat.
4 3	Attribute, in concert with others, could contribute to threat.
2 1	Attribute plays minor role in contributing to threat.
0	Attribute plays no role in contributing to threat – **Lowest Weighting**.

Since the list has only six conditions or threats, each threat/condition represents two numerical values, except zero. Thus, the data collected and the knowledge and experience of Valero's SMEs scoring these attributes determine which score Valero gives to each attribute. (*IMP Training Manual* 2005)

PERFORMING A RISK EVALUATION – COMPREHENSIVE APPROACH

IMP 6 takes in consideration all relevant risk categories when the IMP Engineer evaluates pipeline segments. IMP 6 expresses the Risk of Failure (ROF), which integrates results from the analysis of how pipeline failures could affect HCAs, as the product of the Likelihood of Failure (LOF) and the Consequences of Failure (COF). (*IMP Training Manual* 2005)

Figure 1: Risk Tree



The IMP Engineer processes the results from the integrity assessment and determines which risk factors influence the integrity of the pipeline system, pipe segments, or even a particular section of a pipe. This process of refinement is crucial in the customization of the working algorithm. (*IMP Training Manual* 2005)

PERFORMING A RISK EVALUATION – DRILL DOWN

IMP 6 assesses risk through the use of a relative risk or decision tree algorithms, which when applied to pipeline data, results in the identification of high risk segments and high risk "sections" within segments. Overall characteristics of risk results identify the pipeline locations having the highest estimated risk; IMP 6 also identifies the most important risk drivers for the highest risk locations and the underlying causes of that risk. Risk analysis results account for all modes of pipeline operation. (*Integrity Assessment Report* 2004)

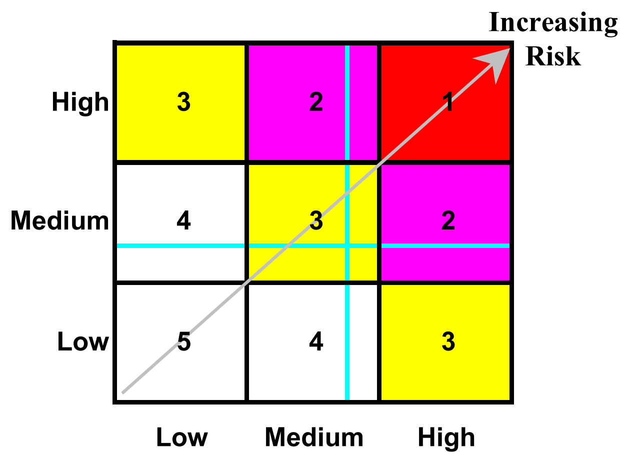
The IMP Engineer uses all results from the analyses with the evaluation models to generate a risk-ranked list of components, which Valero uses in the development of the assessment plan. The ranked list identifies components in the order of ROF and identifies which of the threats are drivers in the ROF of each component. (*Integrity Assessment Report* 2004)

EVALUATING THE COMPARISON CRITERIA OF SEGMENTS

By performing a drill down of these factors, the IMP Engineer identifies the comparison criteria (CC), which categorizes the most important risk drivers for the highest risk locations and the underlying causes of that risk. The CC is determined by where either the sections exceed two standard deviations from the statistical mean of a normal distribution of risk scores or the sections containing risk within the top ten percent of each threat if it does not follow that distribution. Using the results from the CC, the IMP Engineer determines measures to prevent and mitigate the consequence of a pipeline failure that could affect an HCA, including conducting analysis of the pipeline to identify additional actions that will enhance public safety or environmental protection. After identifying the comparison criteria, the IMP Engineer reviews the nine threats vs. COF and takes note of all high risk sections per threat, utilizing the Risk Matrix Report Format (shown in Figure 2). (*Integrity Assessment Report* 2004)

The Risk Matrix Report Format is divided into nine risk sections, which are represented on a three by three grid and the axis limits are based on the maximum calculated algorithm potential threat score and potential COF scores. Each column and row represent an increasing threat from low to high with the threat increasing from left to right for COF scores and bottom to top for scores of each individual threat. The actual pipeline data defined the dynamic segmentation (i.e., the risk evaluation interval). The blue colored lines indicate the comparison criteria, which is the top 10% of risk sections. The risk increases up and to the right in the risk matrix. (*Integrity Assessment Report* 2004)

Figure 2: Risk Matrix Report Format



1=Critical 2=High 3=Medium 4=Low 5=Very Low

Each threat analysis summarizes the variables and associated triggers having the most significant influence on the increased threat scores. The IMP Engineer investigates each of the nine threats against COF and IOP and examines in greater detail any threat that is identified as being a medium or high threat score. (*Integrity Assessment Report* 2004)

CREATING PREVENTIVE AND MITIGATIVE MEASURE SCENARIOS

Valero's Integrity Management Plan for preventive and mitigative (P&M) measures will use the IMP 6 software package to isolate high-risk pipeline segments near HCAs and run risk-reduction scenarios for proposed P&M measures.

Valero's Annual IMP Review Meeting is devoted to reviewing the effectiveness of existing P&M measures; ensuring that any changes to pipeline, facilities, or HCAs are incorporated into appropriate preventive and mitigative programs; and proposing the implementation of new measures. During this meeting, major and minor physical process changes are reviewed for cost-effectiveness with an emphasis on reducing risk on the high-risk pipelines near HCAs as determined from the latest pipeline risk analysis.

The Integrity Engineer creates scenarios using the comparison model in IMP 6 to evaluate proposed P&M measures. The comparison model analyzes the proposed P&M measures against the original risk scores to create scenarios that will reduce risk scores. These scenarios allow the user to perform a “What if” analysis on each of the proposed P&M measures and can then compare those scenarios side-by-side. (*User Reference Manual* 2005)

CONCLUSION

By using risk management software to evaluate the integrity of each pipeline segment as part of the ongoing continual evaluation process, companies ensure that they are analyzing all available information about the integrity of the entire pipeline and the consequences of a failure as well as assuring that they conform to federal regulations.

With the added capabilities of risk management software, companies can perform a risk assessment, identify the highest risk drivers, and incorporate these risk drivers into P&M measures. Utilizing all of this information ensures that companies stay within federal regulations, improves their interdepartmental communications, and aids them in maintaining their pipeline integrity, especially in regards to HCAs. This combination of safe operating practices and risk assessment software creates a winning combination that enhances public safety.

REFERENCES

Bass-Trigon, 2005, *Integrity Management Program Training Manual*, Pages 29-45.

Bass-Trigon, 2004, Valero *Logistics Operations, L.P. Integrity Assessment Report*.

Bass-Trigon, 2005, *IMP 6.2 User Reference Manual,* Page 58-60.