Alyeska pipeline SERVICE COMPANY

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July 9, 2010

Government Letter No.: 21434
APSC File No. 2.11

Mr. Dennis Hinnah
U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
188 West Northern Lights Boulevard, Suite 520
Anchorage, Alaska 99503

RE: Response to Notice of Amendment CPF No. 5-2010-0011M Follow Up

Dear Mr. Hinnah:

Attached please find Alyeska Pipeline Service Company's follow up response to the Pipeline and Hazardous Materials Safety Administration's Notice of Amendment CPF No. 5-2010-0011M, dated March 23, 2010. Alyeska believes that this response will provide adequate clarification and additional information on the findings issued by PHMSA.

> *Finding 1(a): Alyeska's procedures specifically list the gas mainline valve bypass piping as being covered by the procedures. However, the procedures remain silent as to the other locations on the Fuel Gas Line which must also be inspected for atmospheric corrosion.*
>
> *Finding 1(b): Alyeska's procedures do not require atmospheric corrosion inspection frequency of at least once every 3 calendar years, but with interval not exceeding 39 months.*

Alyeska has published revisions to MP-166-3.03, Facility Corrosion Integrity Monitoring (Attached as Exhibit A), and MP-166-3.03-01, Facility Corrosion Integrity Monitoring Engineering and Implementation (Attached as Exhibit B), to address the findings listed above. The portions that have been edited are indicated by the change bars in the left hand margin. These revisions have been updated based on follow-up conversations with APSC and PHMSA personnel.

CERTIFIED MAIL 7007 3020 0002 1186 9608

We hope you will find this material helpful. Should you have further questions, please do not hesitate to contact me at (907) 787-8061.

Sincerely,

Joseph P. Robertson, P.E.
Compliance & Ethics Director

JPR/em

Attachments: Exhibit A - MP-166-3.03, Facility Corrosion Integrity Monitoring
Exhibit B - MP-166-3.03-01, Facility Corrosion Integrity Monitoring Engineering and Implementation

cc: Chris Hoidal
Tom Johnson

1.0 Purpose and Scope

This procedure identifies facility piping systems within the scope of the Facility Corrosion Integrity Monitoring Program commonly referred to and used in this procedure as the Piping Integrity Testing (PIT) Program which is a part of the overall TAPS Corrosion Control Program. The PIT Program's purpose is to assure compliance with the specific State and Federal Regulations and Stipulations outlined below.

A. Facility crude oil and other liquid hydrocarbon systems under the jurisdiction of the Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline, (Stipulations), Exhibit D, paragraph 3.10.1, *49 CFR 195*, Subpart H – Corrosion Control, Transportation of Hazardous Liquids by Pipeline, *18 AAC 75.080* and *ASME B31.4*, "Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids" are:

- All Pump Station Locations
- North Pole and Petro Star Valdez Meter Stations
- Valdez Marine Terminal (VMT)
- Crude Oil Mainline Valve Bypass Lines
- Crude Oil Mainline within belowground corridors
- Crude Oil Mainline branch connection attachment locations
- Facility liquid hydrocarbon piping under the jurisdiction of *18 AAC 75.080*, but not included in the above mentioned codes and regulations
- All belowground liquid fuel piping (turbine fuel, diesel, gasoline, and jet fuel)

B. Facility fuel gas systems under the jurisdiction of the Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline, (Stipulations), Exhibit D, paragraph 3.10.1, *49 CFR 192*, Transportation of Natural and Other Gas by Pipeline, *18 AAC 75.080* and *ASME B31.8*, "Gas Transmission and Distribution Piping Systems", are:

- Fuel Gas Line at Pump Stations aboveground and exposed to the atmosphere
- Fuel Gas Line at above-ground bridge and water crossings
- Fuel Gas Line Valve Bypass Lines
- Aboveground gas distribution piping at the pump stations

C. Facility piping identified under the jurisdiction of *29 CFR 1910.119*, "Process Safety Management of Highly Hazardous Chemicals," and Alaska Department of Labor Statute S1910.119, "Process Safety Management of Highly Hazardous Chemicals," and detailed in *SA-38*, *Corporate Safety Manual*, Requirement 1.3, "Process Safety Management," typically *ASME B31.3* facilities such as:

- VMT Vapor Recovery Systems

D. Facility piping at VMT referenced in *MP-69-1*, Best Management Practices Plan Ballast Water Treatment, Alyeska Marine Terminal, and not included in other sections of this procedure:

- Ballast Water Treatment (BWT) Piping System
- Recovered Crude Piping System

E. Facility Fire System piping at VMT designed to *ASME B31.3* and inspected to meet the requirements under *API 570*, "Piping Inspection Code; Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems."

The Electronic Data Management (EDM) system includes a list of crude oil and fuel gas line piping segments and corrosion data information. Additionally, the PIT Program has an established database which inventories, tracks and accounts for all existing inspection locations. When combined with the crude oil piping corrosion schematics and the cathodic protection drawings and reports, this list provides the inventory of facility piping for the development of the scope of work for implementation of the PIT Program.

2.0 References

Alyeska Documents

Form 10002, Corrosion Investigation Report

AMS-003, Project Management Process

AMS-004, Engineering Process

AMS-017-01, Risk Assessment Procedure

DB-180, Design Basis Update

SUR-10, Belowground Piping or Equipment Integrity Management

CW-200, Records Retention Schedule

Master Specifications

B-511, Pump Station and Terminal Pipe Investigation Specification

B-512, Pipeline Corrosion Evaluation Procedures

MP-69-1, Best Management Practices Plan Ballast Water Treatment, Alyeska Marine Terminal

MP-166-1.00, Integrity Management Programs Process

MP-166-3.01, Corrosion Inhibitors – Pump Stations, North Pole Metering and VMT

MP-166-3.02, Internal Corrosion Coupon Program

MP-166-3.03-01, Facility Corrosion Integrity Monitoring Engineering and Implementation

MP-166-3.04, *Pipeline Integrity Pigging*

MP-166-3.07, *Bimonthly Inspection – Rectifiers and Other Devices*

MP-166-3.18, *Engineering Data Management (EDM) System*

MP-166-3.22, *Pipeline Cathodic Protection Systems*

MP-166-3.23, *Facilities Cathodic Protection Systems*

MR-48, *Trans-Alaska Pipeline Maintenance and Repair Manual*

SA-38, *Corporate Safety Manual*, Requirement 1.3, "Process Safety Management."

Alaska Administrative Code (AAC)

18 AAC 75.080, "Requirements for Facility Oil Piping."

American Petroleum Institute (API)

API 570, "Piping Inspection Code Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems"

American Society of Mechanical Engineers (ASME)

ASME B31.3, "Process Piping"

ASME B31.4, "Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids."

*ASME B31.8, "*Gas Transmission and Distribution Piping Systems"

ASME B31G, "Manual for Determining the Remaining Strength of Corroded Pipelines a Supplement to ASME B31 Code for Pressure Piping"

Code of Federal Regulations (CFR)

29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals."

49 CFR 195.569, "Do I have to examine exposed portions of buried pipelines?"

49 CFR 195.579, "What must I do to mitigate internal corrosion?"

49 CFR 195.581, "What pipelines must I protect against atmospheric corrosion and what coating material may I use?"

49 CFR 195.583, "What must I do to monitor atmospheric corrosion control?"

49 CFR 192.451, "Requirements for Corrosion Control"

49 CFR 192.479, "Atmospheric Corrosion Control: General"

49CFR 192.481, "Atmospheric Corrosion Control: Monitoring"

Other Government Documents

Agreement and Grant of Right-of-Way for the Trans-Alaska Pipeline between the United States of America and the Owner Companies, (Stipulations), Exhibit D, paragraph 3.10.1

Agreement and Grant of Right-of-Way for the Trans-Alaska Pipeline between the State of Alaska and the Owner Companies, (Stipulations), Section 3.10 Pipeline Corrosion

Amendment to Waiver of Cathodic Protection (CP) Requirements on Buried Pump Station and Terminal Insulated Piping, Docket No. P-95-1W; Notice 2, August 29, 1995, found on the TAPS Documents System

3.0 Definitions

Atmospheric Corrosion Control Evaluations
Evaluations or inspections performed in accordance with *49 CFR 192.479*, "Atmospheric Corrosion Control: General," and *49 CFR 192.481*, "Atmospheric Corrosion Control: Monitoring"; and *49 CFR 195.581*, "Which pipelines must I protect against atmospheric corrosion and what coating material may I use," and *49 CFR 195.583*. "What must I do to monitor atmospheric corrosion control?" These evaluations or inspections will be completed on each piping segment on facilities piping on TAPS to ensure practical coverage of the subject segment ensuring full representation of the environmental effect or condition on that leg. These inspections will pay particular attention to pipe at soil-to-air interfaces, under thermal insulation, under disbonded coatings, at pipe supports, in splash zones, at deck penetrations, in spans over water, at flanges and other mechanical joints and non-insulated piping. These inspections will take place in accordance with the required interval as prescribed in the above noted regulatory code sections for 49 CFR 195 and 49 CFR 192.

DMS
Data Management Specialist. See *MP-166-3.18, Engineering Data Management (EDM) System.*

EDM
Electronic Data Management system. Repository of corrosion control program information and associated data.

Fitness-for-Service
That condition following inspection and acceptable analysis per Master Specification *B-512, Pipeline Corrosion Evaluation Procedures*, or after repairs are made to out-of-code conditions that deem a system operable.

Inspection Classification
Equipment or piping rank based on its service, impact on safety and environment, and criticality of operation. Classifications will generally follow *API 570*, Section 6.2 for piping service classes; Classes 1, 2, and 3. With the exception of Class 1 lines installed over, or adjacent to, water at the VMT, other lines are Class 2 and 3.

Inspection Interval or Frequency
The longest period of time that may lapse between inspections. The maximum interval generally is scheduled using the calculation of not more than half the remaining life to the out-of-specification condition

as projected by the corrosion rate. Sample ultrasonic testing (UT) inspection intervals should not exceed 5 years for Class 1 piping and 10 years for Class 2 and 3 piping. At a minimum, new piping segments should be inspected within these periods. Visual inspection intervals are directed to be 5 years for Class 1 and 2 piping and 10 years for Class 3 piping. The inspection intervals described above are based upon *API 570*, *Piping Inspection Code*.

Data Analysis Equations

Grid Corrosion Percent Increase (use nominal thickness if possible)

$$\left(\frac{\text{Maximum Difference}}{\text{Nom. or Average Wall Thickness}}\right)\times 100$$

Grid Short Term Rate

$$\left(\frac{\text{Maximum Difference}}{\text{Years between Inspections (Interval)}}\right)$$

PIT Corrosion Percent Increase

$$\left(\frac{\text{New Deepest Pit - Old Deepest Pit}}{\text{New Deepest Pit}}\right)\times 100$$

PIT Short Term Rate

$$\left(\frac{\text{New Deepest Pit - Old Deepest Pit}}{\text{Years between Inspections (Interval)}}\right)$$

4.0 Accountable Resources

Integrity Management Engineer

- Provides assurance that work is in compliance with relevant codes, standards, and Alyeska specifications, management processes, procedures and contractor work orders as appropriate.
- Assures accuracy of engineering data obtained during monitoring and surveillance activities and stores it appropriately.
- Recommends and documents short and long term monitoring and maintenance activities based on the analysis and trending of data.
- Modifies the procedure as appropriate to meet PIT Program scope and objectives.
- Ensures the maintenance of records, documents, files and relevant information required by regulation and good business practice.

Corrosion Field Engineer

- Collect, compile, and/or compute the field data into usable engineering data in accordance with this procedure.
- Assure proper function of test equipment and assets.

5.0 Procedure

5.1 Data Gathering and Storage

5.1.1 TAPS Facility Corrosion Control Program

The TAPS Corrosion Control Program consists of periodic monitoring and engineered corrosion mitigation activity. Periodic monitoring and certain mitigating activities are outlined in the *MP-166*-series procedures. This procedure works in conjunction with *MP-166-3.01*, *Corrosion Inhibitors – Pump Stations, North Pole Metering and VMT* and *MP-166-3.02*, *Internal Corrosion Coupon Program*. The analysis results of the corrosion coupons removed from the system piping are considered when data from the PIT Program is analyzed. Comparisons and evaluations made between the corrosion monitoring programs aid in determining future actions, inhibitor injections, re-inspection schedules, inspection activity, etc.

The PIT Program for facility piping has six main parts:

1. This procedure, which outlines the scope of the PIT Program and records generated by corrosion inspections and provides evidence that crude oil piping is being maintained *18 AAC 75.080(b)*. Records of corrosion inspections shall be specified and filed in accordance with *MP-166*-series procedures. Inspection requirements are defined in Master Specification, *B-511*, *Pump Station and Terminal Pipe Investigation Specification,* and *MP-166-3.03-01, Facility Corrosion Integrity Monitoring Engineering and Implementation*.

2. The overall scope of TAPS Corrosion Control Program includes all aboveground and belowground crude oil piping. Periodic corrosion surveys typically include cathodic protection monitoring and/or an engineered program of sample inspections for internal and external corrosion performed by nondestructive methods. External corrosion monitoring of belowground (*49 CFR 195, ASME B31.4*) piping systems is included in procedures *MP-166-3.07*, *Bimonthly Inspection – Rectifiers and Other Devices*, *MP-166-3.23*, *Facilities Cathodic Protection Systems,* and *MP-166-3.22*, *Pipeline Cathodic Protection Systems*. External corrosion monitoring of non-DOT crude oil lines is accomplished by a combination of this procedure, *MP-166-3.07* and *MP-166-3.23*.

3. All belowground crude oil piping is examined for deterioration each time a section of buried line is exposed per *18 AAC 75.080(b)(2)(B)*. Instructions for inspection reporting are included in Master Specification *B-511*, and are outlined in *MR-48, Trans-Alaska Pipeline Maintenance and Repair Manual*, sections 2, 9, and 17. Inspection reporting is typically provided on *Form 10002, Corrosion Investigation Report*.

4. If corrosion is found when piping is exposed and examined, the pipe segment will receive another examination and corrective action will be taken to repair the damaged pipe. Action will be taken to control future corrosion as needed per *18 AAC 75.080(b)(2)(C)*. Additional inspections and re-inspections of corrosion-damaged pipe segments are

scheduled and performed according to the corrosion severity and/or rate. Corrosion damaged piping not meeting specification or code requirements will be repaired or replaced and will undergo an additional inspection within the current inspection year or inspection cycle. Inspection on new piping material additions provides a baseline data set with which to establish future corrosion rates at the next required inspection interval. Line segments with lesser amounts of corrosion shall be inspected or re-inspected during the regularly scheduled inspection program. All cumulative corrosion data is reviewed and analyzed in aggregate to determine optimum inspection locations and scheduling. When a corrosion damaged area of a line segment requires repair, engineering action must be taken to evaluate the overall line segment for appropriate corrosion control improvements. Corrosion control improvements must be recommended and implemented as soon as practical.

5. When significant piping repairs or replacements are made, piping must be protected from corrosion by protective wrapping or coating and cathodic protection appropriate for local soil conditions, and be of all-welded construction with no clamped, threaded, or similar connections for lines larger than one-inch nominal pipe size per *18 AAC 75.080(b)(2)(D)* and *18 AAC 75.080(b)(1)*.

6. New installations, repairs, and modifications to existing facilities are performed in accordance with *AMS-003, Project Management Process*, *AMS-004, Engineering Process*, and *DB-180, Design Basis Update*, Section 1.7, "Corrosion Control." Corrosion control practice in design includes materials selection, protective wrapping or coatings, corrosion inhibitors, and cathodic protection systems where appropriate.

5.1.2 Integrity Inspections

Inspections are performed on facilities piping utilizing nondestructive testing (NDT) methods that provide qualitative and quantitative data. Radiographic testing (RT) and ultrasonic testing (UT) methods are employed. Corrosion monitoring practices utilize both the manual ultrasonic testing (MUT) and automated ultrasonic testing (AUT) methods of UT examination. The PIT Program performs RT on piping of 10-inch nominal diameter and less, with piping greater than 10-inch nominal diameter receiving examinations with an ultrasonic method. Piping that has received RT also receives MUT to provide a baseline ultrasonic data set of remaining or minimum wall thickness, to further investigate findings produced by RT or to substantiate the piping wall thickness relative to the thickness determined from radiographic film densitometry practices.

Non-piggable crude oil and tank vapor recovery lines are monitored for serviceability by external inspection methods per this procedure. The primary purpose of integrity monitoring is to determine fitness-for-service. Corrosion inhibitors are used to control internal corrosion per *MP-166-3.01, Corrosion Inhibitors - Pump Stations, North Pole Metering and VMT*. Intrusive monitoring probes are monitored per *MP-166-3.02, Internal Corrosion Coupon Program*. Master Specification *B-511* and *MP-166-3.03-01* further define these inspection criteria.

5.1.3 External Corrosion Monitoring

External corrosion monitoring includes non-DOT crude oil lines. External corrosion monitoring of belowground non-DOT crude oil lines is accomplished by a combination of this procedure, *MP-166-3.07* and *MP-166-3.23*. Non-DOT, *18 AAC 75.080* crude oil piping includes the liquid fuel piping systems consisting of turbine fuel, diesel fuel, gasoline, JP-4 fuel, and ancillary crude oil piping systems at VMT. These lines are typically *ASME B31.3* piping. Master Specification *B-511* defines the inspection criteria for this monitoring scope. External corrosion monitoring of belowground *ASME B31.4* piping systems is included in *MP-166-3.04, Pipeline Integrity Pigging, MP-166-3.07, MP-166-3.22,* and *MP-166-3.23*.

5.1.4 Atmospheric Corrosion Control

Inspection of facility piping to include DOT and non-DOT crude oil and fuel gas piping to monitor atmospheric corrosion will be performed in accordance with, and to satisfy the requirements of, *49 CFR 195.583*, *"What must I do to monitor atmospheric corrosion control?"* and *49 CFR 192.481, "Atmospheric Corrosion Control:Monitoring"*. The PIT Program, under this procedure and further supported by *MP-166-3.03-01*, provide the process and documentation requirements to insure satisfactory completion of the attributes referenced under *49 CFR 195.583*, paragraphs (a), (b) and (c) and *49 CFR 192.481,* paragraphs (a), (b) and (c).

The PIT Program shall provide for the necessary visual examinations and when necessary NDT of facility piping for both DOT and non-DOT regulated systems or segments, mainline valve crude by-pass piping and the mainline natural gas pipeline valve by-pass piping and appurtenances. Additionally, the PIT Program shall provide for the periodic examinations of the mainline segments in the belowground corridor locations at pump stations within the time frame prescribed in *49 CFR 195.583* and *49 CFR 192.481* as applicable. This piping will be scheduled for atmospheric corrosion evaluations providing for a three year cycle.

The PIT Program provides for piping systems to be identified into smaller segments in accordance with *API 570*, as further described in Section 5.1.6 of this procedure. As the program inspection protocol provides, each piping segment shall receive inspections monitoring for internal and external corrosion. The inspection locations shall be selected based upon certain drivers such as: known corrosion, half-life re-inspection interval and/or asset requests. Inspection locations are also selected to include and will pay particular attention to piping with insulation and degraded insulation protection as well as flange connection locations and soil-to-air interfaces. The surface condition of the piping shall be examined for corrosion and the condition of coatings as applicable. Piping located both indoors and outdoors shall be included.

Evaluations are made and results documented with any necessary actions for remediation provided by the Integrity Management Engineer or their designee. The results of the inspections are documented in accordance with the program data storage requirements as further described in Section 5.2.1 of this procedure.

Final assessment of external corrosion shall be made by the Integrity Management Engineer or their designee. This assessment will evaluate the need for remediation of external corrosion determined to be affected by atmospheric conditions and will consider the requirements and provisions of *49 CFR 195.581* and *49 CFR 192.481* as a basis in the decision making process.

Actual site conditions will be documented and if corrosion remediation is deemed necessary, it may be performed insitu under the PIT Program or incorporated at a future date under the Alyeska work management process. All results and engineering requirements will be documented under the PIT Program reporting process outlined under Section 6.0 of this procedure.

5.1.5 Special Inspection Locations

The Integrity Management Engineer shall provide inspection criteria in accordance with the amendment to the August 16, 1975 waiver (Docket No. Pet. 75-13W) from compliance of coating and cathodic protection requirements of *49 CFR 195.238(a)(5)* and *195.242(a)* for buried pump station and terminal insulated piping.

5.1.6 PIT Program Inspection Schedule

The PIT Program performs the annual facilities piping inspections incorporating a line-wide approach to completing the required inspections at all of the pipeline facilities, mainline valve by-pass piping and the VMT. The PIT Program treats TAPS as one continuous system with regard to inspection philosophy. This approach allows for a continuous inspection cycle with inspections completed each year at the facilities. Inspection locations are selected at each facility or remote location based upon calculated half-life inspection intervals, asset request, previously known corrosion data and program baseline investigations.

The PIT Program employs a progressive approach to corrosion investigations on piping systems. Interval inspections are continued based upon the methods described in this procedure for identifying the next scheduled inspection. Further, the program continuously assesses the facilities piping systems to identify new locations for corrosion inspections. This includes working directly with the operating assets to assess the systems and walking down systems as necessary to evaluate for new atmospheric corrosion control locations, areas of concern, piping flow directional changes, etc. This continuous process improvement philosophy allows the program to consistently be able to evaluate new locations on piping systems while maintaining the evaluations for longer term corrosion monitoring of existing locations.

Facility piping is organized or segmented into unique operating environments or line segments (legs) to which inspection classifications are assigned in accordance with *API 570*. Half-life sample inspection intervals or frequencies are based upon projected failure dates calculated for each leg using the RSTRENG method. The actual grid corrosion strings and an assumed or actual corrosion rate are used to determine the future date when the leg will be in an out-of-code condition. Actual corrosion rates may be determined from inspection history or corrosion coupon data.

An annual scope of work for pipe segment inspections is typically determined using the half-life scheduling method identified above. Field inspections and fitness-for-service calculations are performed in accordance with Master Specification, *B-511*. In addition to the aforementioned methods for determining the annual scope of work, requests for inspections are typically received from the Operating Assets on piping systems that are of interest to the facility for reasons that may include criticality to the system for uninterrupted operational performance, high pressure systems, history of corrosion concerns, operational changes etc.

5.2 Data Analysis

5.2.1 Data Storage

The data obtained from the inspections performed by the PIT Program are entered and archived into the Electronic Data Management (EDM) system. The inspection data obtained from individual inspection grid locations as well as atmospheric corrosion evaluations, once analyzed, is loaded into the EDM system where it can be retrieved for future use for system analysis, to aid in determining future inspections, to identify the system health of a piping segment at a facility, or to trend corrosion rates of a pipe segment.

5.2.2 Fitness-for-Service Procedure

Final acceptable analysis for fitness-of-service shall be performed per Master Specification *B-511*. More conservative interim analysis may be performed for screening purposes to expedite the inspection and analysis process. Two acceptable procedures for conservative interim analysis include using:

1. *ASME B31G* method; and,
2. *ASME B31G* method assuming maximum longitudinal extent of corrosion such that Part 4.2(b) factor A is greater than 4.0.

5.2.3 Corrosion Control Improvements

Alyeska's policy for corrosion control planning for crude oil and hydrocarbon vapor systems allows for a prioritized or risk-based approach to corrosion control. Alyeska's Risk Assessment Procedure is defined in *AMS-017-01*. This method requires periodic excavation inspections and/or CP monitoring of buried piping. Corrosion control for the purpose of safety and reducing risk of crude oil discharge may include pipe replacement, pipe remode (moving belowground pipe to aboveground mode), removing piping systems from service, and installing or upgrading cathodic protection systems.

5.2.4 Piping Removed From Service

When piping is permanently removed from service due to the results of the corrosion investigations, a visual inspection will be performed on the affected piping segment, the pipe and any associated components (flanges, fittings, valves, etc.), and the adjacent piping both upstream and downstream. Once the removed materials have been inspected and documented, they can be discarded. A person qualified and experienced such as a Corrosion Field Engineer (CFE) shall perform the required inspections.

The results of the inspections will be documented on a Corrosion Investigation Report (CIR) and/or Flange Examination Report (FER). The reports shall be submitted to the Integrity Management Engineer. A hard copy of the CIR and/or FER will be placed in the Integrity Management Engineering files and the PIT Program database will be updated to reflect the removal of the piping. As necessary (if existing inspection sites/grids are affected); a electronic CIR will be completed in EDM identifying the results and piping replacement information. As a result of any newly installed piping, a baseline inspection will be scheduled under the PIT Program to take place within one year not to exceed 15 months after the piping installation.

6.0 Reporting

The Integrity Management Engineer summarizes the results of monitoring activities and proposes recommendations to the assets in the Pipeline and Terminal Facilities Integrity Management Annual Report in accordance with *MP-166-1.00, Integrity Management Programs Process*.

7.0 Records

UT/Pit Gauge data (facility)	All records generated as a result of this document will be retained in accordance with *CW-200, Records Retention Schedule*.
Notification of allowable pressure below MOP, non-mainline	
CIR (Corrosion Investigation Report)	
FER (Flange Examination Report)	
Copies of UT Field File/ Calibration Sheets	
Radiographic Film and Reports	

All of the above records are generated as a result of specifications *B-511*.

8.0 Revision History

Approved by Charles Southerland, Engineering Integrity Management Supervisor		
Revision	**Date**	**Revision Summary**
11	05/20/10	• Revision of Sections 1.0, 2.0, 3.0 and 5.1.4 to explicitly specify adherence to atmospheric corrosion monitoring requirements in 49 CFR 192.481.
10	12/29/09	• Performed Scheduled Review and updated document throughout to align with current standards and policies.
9	04/25/08	• Complete Review. • Section 4: Revised heading to read Accountable Resources to more closely align with the Accountability Leadership Initiative. • Addition of Section 5.1.4: Atmospheric Corrosion Control. • Addition of Section 5.2.3: Corrosion Control Improvements. • Addition of Section 5.2.4: Piping Removed From Service • Section 5.1.6: Revision • Verified and updated references throughout document.
8	01/31/08	• Revised title and Unique ID of reference to *AMS-017* (now *AMS-017-01*).
7	04/12/06	• Revised to reflect the current PIT Program line wide inspection plan • Revised to represent the supporting MP-166-3.03-01 procedure • Deleted all references to Alyeska Master Specification B-513 • Updated Records section.
6	04/27/05	• Updated reference titles and document unique I.Ds: *MP-166-3.22* and *MP-166-3.23*.
5	03/23/05	• Complete review
4	01/22/03	• Reformatted to current standards • PM-2001 references replaced with AMS-003 and AMS-004 • 2.0 References: 49 CFR 195 references updated • 5.0 Procedure: Revised sections 5.1.1

Approved by Charles Southerland, Engineering Integrity Management Supervisor		
Revision	**Date**	**Revision Summary**
3	04/30/00	• No specific information available.
2	04/30/99	• No specific information available.
1	06/15/98	• No specific information available.
0	06/02/97	• This document was housed in MP-166, Ed. 2, Rev. 0. It replaced MP-2.6.

1.0 Purpose and Scope

This procedure defines the practices for engineering and implementation of the Facility Corrosion Integrity Monitoring Program commonly referred to and used in this procedure as the Piping Integrity Testing (PIT) Program defined in the Integrity Management Engineering Monitoring Procedure *MP-166-3.03, Facility Corrosion Integrity Monitoring*. The procedure's purpose is to specify the necessary detailed information to ensure a consistent, structured method of implementing the annual PIT Program. This procedure outlines the steps involved to develop the scope of work (SOW), implementing the SOW, analyzing the data, and reporting the PIT Program results.

The piping systems and facility locations covered by this procedure are as follows:

A. Facility crude oil and other liquid hydrocarbon systems under the jurisdiction of the Agreement and Grant of Right-of-Way for the Trans-Alaska Pipeline, (Stipulations), Exhibit D, paragraph 3.10.1, *49 CFR 195*, Subpart H, "Corrosion Control," *18 AAC 75.080*, "Requirements for Facility Oil Piping," and *ASME B31.4*, "Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids" are:

- All Pump Station Locations
- North Pole and Petro Star Valdez Meter Stations
- Valdez Marine Terminal (VMT)
- Crude Oil Mainline Valve Bypass Lines
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- Crude Oil Mainline within belowground corridors
- Crude Oil Mainline branch connection attachment locations
- Facility liquid hydrocarbon piping under the jurisdiction of *18 AAC 75.080,* but not included in the above mentioned codes and regulations.
- All belowground liquid fuel piping (turbine fuel, diesel, gasoline, and jet fuel)

B. Facility fuel gas systems under the jurisdiction of the Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline, (Stipulations), Exhibit D, paragraph 3.10.1, *49 CFR 192*, Transportation of Natural and Other Gas by Pipeline, *18 AAC 75.080* and *ASME B31.8*, "Gas Transmission and Distribution Piping Systems", are:

- Fuel Gas Line at Pump Stations aboveground and exposed to the atmosphere
- Fuel Gas Line at above-ground bridge and water crossings
- Fuel Gas Line Valve Bypass Lines

- Aboveground gas distribution piping at the pump stations

C. Facility piping identified under the jurisdiction of *29 CFR 1910.119*, "Process Safety Management of Highly Hazardous Chemicals," and Alaska Department of Labor Statute S1910.119, "Process Safety Management of Highly Hazardous Chemicals," and detailed in *SA-38, Corporate Safety Manual*, Requirement 1.3, "Process Safety Management," typically *ASME B31.3* facilities such as:

- VMT Vapor Recovery Systems

D. Facility piping at VMT referenced in *MP-69-1*, Best Management Practices Plan Ballast Water Treatment, Alyeska Marine Terminal, and not included in other sections of this procedure:

- Ballast Water Treatment (BWT) Piping System
- Recovered Crude Piping System

E. Facility Fire System piping at VMT designed to *ASME B31.3* and inspected to meet the requirements under *API 570*, "Piping Inspection Code; Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems."

The Electronic Data Management System (EDM) includes a list of crude oil and fuel gas line piping segments and corrosion data information. Additionally, the PIT Program has an established database which inventories, tracks and accounts for all existing inspection locations. When combined with the facilities piping corrosion drawings and the results of previous inspections of facility piping, the annual SOW for implementation of the PIT Program can then be developed.

2.0 References

Alyeska Documents

Form 3619, Pipeline Investigation Report

Form 10002, Corrosion Investigation Report

Form 10009, Flange Examination Report

Form 10299, UT Calibration Field File Record

B-510, Mainline Pipe Investigation

B-511, Pump Station and Terminal Pipe Investigation Specification

B-512, Pipeline Corrosion Evaluation Procedures

CW-200, Records Retention Schedule

MP-69-1, Best Management Practices Plan Ballast Water Treatment, Alyeska Marine Terminal

MP-166-1.00, Integrity Management Programs Process

MP-166-3.03, Facility Corrosion Integrity Monitoring

NDT-TP-708, Nondestructive Testing (NDT) of Pipeline for Integrity Assessments

SA-38, Corporate Safety Manual

Alaska Administrative Codes (AAC)

18 AAC 75.080, "Requirements for Facility Oil Piping"

American Petroleum Institute (API)

API 570, "Piping Inspection Code Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems"

American Society of Mechanical Engineers (ASME)

ASME B31.3, "Process Piping."

ASME B31.4, "Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids."

ASME B31.8, "Gas Transmission and Distribution Piping Systems"

ASME B31G, "Manual for Determining the Remaining Strength of Corroded Pipelines," a Supplement to the ASME B31 Code for Pressure Piping."

Code of Federal Regulations (CFR)

29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals"

49 CFR 192.451, "Requirements for Corrosion Control"

49 CFR 192.479, "Atmospheric Corrosion Control: General"

49 CFR 192.481, "Atmospheric Corrosion Control: Monitoring"

49 CFR 195, Subpart H, "Corrosion Control"

49 CFR 195.581, "Which pipelines must I protect against atmospheric corrosion and what coating material may I use"

49 CFR 195.583, "What must I do to monitor atmospheric corrosion control?"

3.0 Definitions

Actionable

"Actionable" represents an effect of significant wall loss due to corrosion. The lower limit or that percent wall loss due to corrosion conditions considered actionable is 20%. This "action" may include any of, or a combination of any of the following: additional inspection sites/grids added, increased inspection frequency, coupon monitoring, corrosion inhibitor injection or material replacement.

Atmospheric Corrosion Control Evaluations

Evaluations or inspections performed in accordance with *49 CFR 192.479*, "Atmospheric Corrosion Control: General," and *49 CFR 192.481*, "Atmospheric Corrosion Control: Monitoring"; and *49 CFR 195.581*, "Which pipelines must I protect against atmospheric corrosion and what coating material may I use," and *49 CFR 195.583*. "What must I do to monitor atmospheric corrosion control?" These evaluations or inspections will be completed on each piping segment on facilities piping on TAPS to ensure practical coverage of the subject segment ensuring full representation of the environmental effect or condition on that leg. These inspections will pay particular attention to pipe at soil-to-air interfaces, under thermal insulation, under disbonded coatings, at pipe supports, in splash zones, at deck penetrations, in spans over water, at flanges and other mechanical joints and non-insulated piping. These inspections will take place in accordance with the required interval as prescribed in the above noted regulatory code sections for 49 CFR 195 and 49 CFR 192.

Baseline Corrosion Rate

A corrosion rate calculated from the minimum remaining wall (deepest pit measured) and the nominal wall or actual wall thickness of the baseline inspection or the assumed original installation date.

Baseline Inspection
First inspection at a grid location. New piping installations should receive their baseline inspection within one (1) year not to exceed 15 months after being placed into service. This baseline inspection will include manual ultrasonic testing (MUT). Radiographic testing will also be completed on 10-inch nominal pipe size and under.

Binder Files
Three-ring binders where hard copy inspection grid data and information for each PIT Program inspection grid are stored. These reside in Valdez and each year the Integrity Management Engineer (IME) ensures all data files are updated.

Combo File
Short for "combination file." These files are an electronic compilation of all existing ultrasonic data from a manual or automated grid inspection represented in Excel by their alpha-numeric grid pattern. These depict the point inspection data from the 1-inch grid pattern or matrix and provide the minimum thickness for each alpha-numeric coordinate. As a re-inspection takes place, the new grid matrix is added to the grid's associated Combo File to represent the entire history under one file location.

EDM
Electronic Data Management system. Repository of corrosion control program information and associated data.

Fitness-for-Service
That condition, following inspection and analysis (per applicable Alyeska master specification as outlined in the reference section of this procedure), and/or completed repairs that assure a system is operable.

Inspection Classification
Equipment or piping designation based on its service, impact on safety and environment, and criticality of operation. Classifications will generally follow *API 570,* "Piping Inspection Code Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems", Section 6.2 for piping service classes; Classes 1, 2, and 3. With the exception of Class 1 lines installed over, or adjacent to water at the VMT, other lines are Class 2 and 3.

Inspection Interval or Frequency
The allowable period of time that may lapse between inspections as determined by either half-life calculation or *API 570* classifications. The maximum interval is generally determined using the calculation of not more than half the remaining life of the subject piping contingent to its measured corrosion condition, as projected by the established corrosion rate. Sample ultrasonic testing (UT) inspection intervals should not exceed 5 years for Class 1 piping and 10 years for Class 2

and 3 piping. Visual inspection intervals are directed to be 5 years for Class 1 and 2 piping and 10 years for Class 3 piping. The inspection intervals described above are based upon *API 570*. The PIT Program uses this definition for piping in all design classes.

Interval Corrosion Rate

A corrosion rate calculated by subtracting the minimum remaining wall (deepest corrosion pit measured) from the nominal wall or actual wall thickness, over the last interval inspection period.

Interval inspection

Reoccurring inspection based on a calculation using a corrosion rate to determine the next required inspection date.

PIT CID Manual

This is a "desk-top" reference that provides the basic instruction on how to operate and navigate through the PIT Program database for the various required activities outlined in this procedure. This is included as Attachment 1, "PIT CID Manual" of this procedure.

PIT Database

The electronic files and folders that contain and collect inspection data for each inspection grid completed or pending, under the PIT Program. These are available for review in both Microsoft Access and Excel format located under the Alyeska F: Drive within the Pipeline Integrity Team folder and under a subfolder titled "PIT Program." This folder generally limits access to only those individuals directly involved in the program.

Data Analysis Equations

Grid Corrosion Percent Increase (use nominal thickness if possible)

$$\left(\frac{\text{Maximum Difference}}{\text{Nom. or Average Wall Thickness}}\right)\times 100$$

Grid Short Term Rate

$$\left(\frac{\text{Maximum Difference}}{\text{Years between Inspections (Interval)}}\right)$$

PIT Corrosion Percent Increase

$$\left(\frac{\text{New Deepest Pit - Old Deepest Pit}}{\text{New Deepest Pit}}\right)\times 100$$

PIT Short Term Rate

$$\left(\frac{\text{New Deepest Pit - Old Deepest Pit}}{\text{Years between Inspections (Interval)}}\right)$$

4.0 Accountable Resources

Integrity Management Engineer (IME)

- Provides assurance that work is in compliance with relevant codes, standards, Alyeska Pipeline Service Company (APSC) specifications, management processes, procedures and contractor work orders as appropriate.
- Ensures accuracy of engineering data obtained during monitoring and surveillance activities performs analysis and ensures proper archival of data.
- Recommends and documents short and long term monitoring and maintenance activities based on the analysis and trending of the collected data.
- Identifies preliminary SOW based upon PIT Program Database queries and compiles Asset requests for consideration into the preliminary SOW.
- Establishes and assigns tasks to the Corrosion Field Engineer (CFE) and ensures implementation package is developed.
- Recommends final SOW.
- Modifies the procedure as appropriate to meet program scope and objectives.
- Ensures the maintenance of drawings, records, documents, files and relevant information required by regulation and good business practice.
- Ensures requirements for inspection interval based upon calculated, code or government regulations are correct and completed with in the prescribed time frame.

Corrosion Field Engineer (CFE)

- Develops the detailed SOW based upon the IME assigned preliminary information resulting from the PIT Program database queries and Asset requests.
- Updates the electronic program drawings to reflect the SOW sites and grids as necessary. Submits those electronic versions to the IME at the conclusion of the work season.
- Completes assigned tasks as defined by the IME to support the SOW development and the development of the implementation package.
- Collects, compiles, analyzes and converts the field data into usable engineering data in accordance with this procedure.
- Ensures the proper function and usage of test equipment and associated assets.
- Provides field oversight of inspection personnel and coordinates labor activities to support the SOW as the IME designee.

NDT Technician

- Performs nondestructive testing (NDT) of PIT Program corrosion inspection grids using appropriate technology, tools and equipment.
- Provides reports, records and final documentation of examinations to the CFE upon completion of inspection grids. Upon completion of annual program, the NDT Technicians shall ship all radiographic film to IME in an Alyeska-approved water-tight shipping case.
- Ensures all digital radiographic images have been routed through to the CFE for proper archival.

Asset Manager

- Approved the IME recommended SOW for the Asset.
- Request locations for inspection under PIT Program as needed.

5.0 Procedure

5.1 Scope of Work (SOW) Development

The IME or designee shall be responsible for developing the detailed SOW for each program year. The SOW shall be developed based upon:

1. PIT Program Database ½ life calculated reinspection interval;
2. Asset requests;
3. Results from the previous inspection year;
4. Pipe segment frequency and/or baseline inspection requirements; and
5. DOT regulatory required period for atmospheric corrosion evaluations (*49 CFR 192.479* and *49 CFR 192.481*, and *49 CFR 195.581* and *49 CFR 195.583*).

The PIT Database shall be reviewed for those inspection grids that reflect the re-inspection year of interest for SOW development. All Asset requests shall be reviewed by the IME. This review shall determine the applicability of the request and shall take into consideration the known piping inspection data related to the request. Asset personnel may need to be included in the analysis of the request to best determine the applicability. Once the Asset requests have been finalized they shall be added to the SOW. Results from previous years' inspections shall also be used to determine the final SOW. This can be accomplished by utilizing the reports developed from previous years' completed SOW and/or the inspection data files.

The detailed SOW shall be presented in Excel spreadsheet format or other appropriate format (i.e., Microsoft Access format) on the following working spreadsheets utilized by the PIT Program: SOW Spreadsheet, PIT Report, and CFE Checklist.

The SOW spreadsheet provides the fundamental details of each inspection grid to be investigated. It provides basic information to the support contractors (labor and inspection) to complete their cost estimates. It also provides the basic inspection grid information to the Asset personnel and management to understand the work that will be completed at their facility.

The PIT Report is the working spreadsheet used by the IME and CFE to input the inspection and corrosion data during implementation. Calculations and comments based upon the inspection results are made within the spreadsheet for future analysis. It provides information at a glance to evaluate the integrity of each inspection grid. This sheet is used in conjunction with the Combo Files and RSTRENG Files (discussed in Section 5.3, “Analyzing Data”).

The CFE Checklist tracks status and is used to verify implementation steps are completed. The CFE populates this spreadsheet as work is being performed to verify all work is captured by the program and its contractors. This spreadsheet is also documents any changes to the SOW (based upon field findings), which is then transferred to the PIT Report.

Within this procedure the referenced spreadsheets shall also be referred to as “Program spreadsheets.” When using this reference it shall be understood to mean all three of the subject spreadsheets. Each of these spreadsheets is also integral to the PIT Database.

The IME completes the following steps to develop the SOW, (refer to Attachment 1, “PIT CID Manual,” for instructions on the use of the PIT Database):

1. For locations previously inspected, import the current year inspection grid records identified for the SOW from the PIT Database into each program spreadsheet. The grid “rows” on the spreadsheets shall be identified or grouped by pump station or mainline by-pass piping for the pipeline portion of the program and by Asset location for the VMT.

2. The PIT Database is used to help define the SOW. Two queries are made in the database to identify those inspection grids that are due for re-inspection. The first query, called “Grids Due for Inspection,” considers grids that are both active and current. The second query called, “Leg Due” considers all grids and inspections regardless of the active and/or current status. The results of this query shall be reviewed, researched and compared against the first query to ensure that the relevant inspections have not been overlooked. The SOW is then defined by using additional menu tabs in the PIT Database relative to the current year. Reference Attachment 1, “PIT CID Manual,” which identifies all of the steps for establishing the SOW and using the PIT Database.

3. The IME will review the PIT Program corrosion drawings and select the pipe segments for consideration of atmospheric corrosion evaluations. Inspection locations are selected to include and will pay particular attention to piping with insulation and degraded insulation protection as well as flange connection locations, soil-to-air interfaces and other mechanical joints and piping components. Piping may be located both indoors and outdoors. A progressive approach will be taken to ensure adequate piping segment coverage is made and complies with the DOT regulatory period for atmospheric corrosion evaluations of facilities piping. The IME shall ensure that each facility pipe segment is represented in the SOW with

locations uniquely identified for atmospheric corrosion evaluations and that these locations are representative of the overall environmental conditions in which that pipe segment (leg) experiences during normal service conditions.

The IME will provide place holders in the SOW documents to allow future identification, documentation and reporting of atmospheric corrosion evaluation locations. Each atmospheric corrosion evaluation location will receive program site identification and be placed on the PIT Program corrosion drawings and all relevant database files and reports.

4. Export or display each grid record identified from the PIT Database into the program spreadsheets. The spreadsheets can be exported in Excel format or printed directly from Access. Complete all columns of each spreadsheet as applicable. Use the PIT Program Binder Files and program corrosion drawings as necessary to aid in populating the program spreadsheets. Create a Combo File and RSTRENG file for each pending interval inspection grid. Grid identification shall be consecutive and in accordance with *NDT-TP-708, Nondestructive Testing (NDT) of Pipeline for Integrity Assessments*.

5. Asset requests shall be evaluated by the IME and/or their designee. Research the requested locations to determine if existing inspection grids are present. If so, the data shall be retrieved from the database and field records previously developed, and/or transferred onto the program spreadsheets. If the request areas do not contain existing inspection grids, the location shall be investigated and a new inspection grid (baseline inspection) developed in accordance with *NDT-TP-708* and *B-511*, *Pump Station and Terminal Pipe Investigation Specification*. When necessary, the IME or CFE visits the field location, acquires digital photos, creates a field sketch and/or adds the location to the appropriate corrosion drawings. A new grid record (record) shall be created in the PIT Database in preparation for inspection. Populate all columns of the program spreadsheets as applicable. Use the PIT Program corrosion drawings as necessary to aid in populating the program spreadsheets. Create a hard copy file folder for the baseline inspection grid within the PIT Program Binder Files. A Combo File and RSTRENG file shall be created for the new (or interval) inspection grid.

6. Results from the previous inspection year will often yield interval inspections. This information can be obtained from the PIT Program Year End Annual Report from the previous program year. This information shall be used to create the interval inspection grid for the SOW development. The data for the interval grid location can be obtained from the previous years' program spread sheets, PIT Database, Combo Files, and RSTRENG files. Populate all columns of the PIT Database and each spreadsheet as applicable. Use the PIT Program Binder Files and program corrosion drawings as necessary to aid in populating the PIT Database and program spreadsheets. Create a Combo File and RSTRENG file for the interval inspection grid. Grid identification shall be consecutive and in accordance with *NDT-TP-708.*

7. The IME or CFE revises each affected PIT Program drawing by building a scan layer for the applicable inspection year. AutoCAD shall be used for this process. The scan layer shall represent each inspection grid identified on the SOW. Each grid shall be identified by its

alpha-numeric designator from its' respective scan name within a bubble and have a connecting line showing the approximate location on the applicable piping segment. All identified pipe segments applicable to the SOW shall be "color coded" (exceptions to this may be belowground piping and drain lines). These revised program SOW drawings shall be saved to the F:Drive PIT Program folder.

8. The IME or designee develops the program implementation instructions. The instruction write-up shall provide the basic details of what work is to be completed during the season, and the facilities in which they will be conducted. It shall identify the responsible personnel at each facility and their contact numbers. It shall provide an index of the contents of the implementation package (i.e., drawing numbers, specification and procedures numbers, etc.). It shall provide any special or unique information that may be of interest to a facility or asset or any information regarding other affected work and safety or environmental concerns. It shall identify the external corrosion remediation and coatings applications required for the program. These instructions *shall not* identify scope details for inspection sites or grids, nomenclature for grid identification or details of the methods or approach taken to develop or implement the SOW.
9. The IME develops the implementation schedule. The duration of activities at each facility or location is based on inspection contractor cost estimates that provide inspection duration. The IME derives any dates by projecting the date from the estimated start date and using consecutive calendar days. Consider R&R breaks in the schedule.
10. The IME reviews the DRAFT implementation package including all specifications and/or addenda, implementation instructions, PIT Program spread sheets, drawings and any other referenced documents or attachments. Check the SOW spreadsheet against the drawings on a grid-by-grid basis (or site-by-site) to verify accuracy.
11. The IME and/or designee shall assemble the final program implementation package for the PIT Program. This package includes: 1) implementation instructions; 2) program implementation schedule; 3) all relevant specifications and work procedures; 4) Program spread sheets; and 5) relevant drawings. The IME reviews the implementation package with the Assets before work begins.
12. Reference Attachment 1, "PIT CID Manual," for details on PIT Database use.

5.2 Implementation

Implementing the PIT Program SOW involves not only the field work but also administrative preparation and support. The IME facilitates the steps to effectively engage the CFE, inspection and labor crews into the field activities. This process involves acquiring cost estimates, development of Passport work requests and work orders, distribution of the implementation package (hard copy as necessary and electronic copy to shared folder), distributing the schedule electronically, providing notification to asset personnel and scheduling kick-off meetings. If work orders are developed directly by the contractors supporting the PIT Program, the IME shall be responsible for reviewing and obtaining the necessary approvals by the Integrity Management Supervisor or Alyeska Project Manager as applicable.

After the implementation crews have been mobilized to the field, the CFE is accountable for the following:

- assembly of field file packages for inspection grids
- inspection and labor crew coordination
- inspection grid location/identification
- on-site coordination with facility
- receipt of all required inspection data/documents
- data review/input and assurance of work scope completion (i.e., CFE Checklist)

The duties of the NDT Technician involve performing the required corrosion inspections, documenting those inspection results and reporting the results. The NDT Technicians shall have work locations that are assigned by the CFE. The labor crew prepares the inspection location for NDT. Once available for inspection, each grid undergoes NDT as directed by the CFE and/or outlined in the SOW Implementation Package. Once complete the NDT Technician documents and reports the results.

5.2.1 IME Implementation Accountabilities

Each of the major accountabilities regarding implementation is outlined in detail to provide a consistent process for PIT Program implementation.

1. Upon SOW approval per Section 5.1, “Scope of Work (SOW) Development,” Step 11, the IME obtains cost estimates from the inspection contractor and the labor contractor for their support of the approved SOW. The IME provides copies of the implementation package to each contractor for review and cost estimation. The IME specifies a date in which the estimates are needed. Once the cost estimates are received the IME reviews them with the Integrity Management Engineering Program Lead and/or their Supervisor. Any discrepancies or concerns are discussed with the applicable contractor.
2. Upon cost estimate approval the IME shall develop or will have developed, all work orders and tasks to support the SOW. The IME verifies that all cost estimate documents are provided in Passport under the applicable work order task for review and approval by the Integrity Management Engineering Program Lead or Supervisor, or appropriate Alyeska Project Manager. The IME ensures that the contractors are notified of their work order approvals.
3. The IME provides the Assets any hard copies of the implementation package if necessary or requested. The IME places an electronic copy of the implementation package in a shared drive folder and provides by e-mail the folder location to the affected Assets and personnel.

4. The IME distributes a copy of the implementation schedule to the affected Assets and personnel. This may be updated and re-sent periodically to reflect any schedule changes.
5. The IME notifies the Assets of the pending arrival of the implementation crews to their facilities. This also includes the expected duration at the facility and any contact information relevant to the program.
6. The IME facilitates program kick-off meetings and all interim meetings to provide status updates. Interim meetings shall be scheduled based upon need and program schedule.
7. Reference Attachment 1, “PIT CID Manual,” for details on PIT database use.

5.2.2 CFE Implementation Accountabilities

1. A field file for each inspection grid is assembled as necessary. This field file may contain sketches, previous inspection data, and digital photos. These field files are used by the CFE and/or inspection crew to locate or identify interval or baseline inspection locations and identify any areas of special interest (e.g., a previous low reading point).
2. The CFE coordinates the efforts of the inspection crew and labor crew. The CFE performs a walk-down and locates or identifies for the laborers any areas that need to be stripped of insulation, coating, or locations requiring scaffold, ladders etc. The CFE identifies all inspection grid locations for the inspection crew, completes a walk-down as necessary and ensures that all required labor support work has been completed, making the grid ready for inspections. The CFE ensures all labor support work is completed after the inspections are complete (i.e., scaffold removal, coatings application, reinsulation, etc.).
3. During the performance of the walk down of the inspection sites, the CFE will verify the tentative locations of the atmospheric corrosion evaluations sites as being applicable or appropriate to meet the necessary regulatory requirements and satisfy the integrity needs. The CFE will adjust the locations as necessary to insure coverage of critical components and capture any corrosion concerns identified. The CFE will update the necessary database files, reports and drawings to reflect the actual locations determined and provide unique location identification in accordance with Alyeska specifications.
4. The CFE examines all prepared NDT sites for the presence of external corrosion or corrosion under insulation (CUI). Results of the field examination are recorded on an electronic and/or hard copy (as applicable) Corrosion Inspection Report (CIR) and/or Flange Examination Report (FER). This examination will also provide the necessary evaluations of coating condition if applicable. For locations specifically identified for atmospheric corrosion evaluations, the CFE shall evaluate the piping as defined for flange and stud-bolt corrosion, corrosion at pipe supports, insulation condition (if applicable) and any other configurations or conditions that would be detrimental to adequate corrosion control from atmospheric conditions. In addition to completing the CIR and/or FER report, the CFE also reviews the existing grid site information to verify if adequate site sketches exist or if new or updated sketches are required to locate the grid for future interval inspections.

5. The CFE informs the appropriate facility personnel of the activities to take place. This includes a meeting (can be informal) with the responsible facility lead or supervisor upon arrival to the facility. The CFE will provide periodic communication and, when necessary, coordination (e.g., planning around other facility work) with the facility lead or supervisor while program work is in progress.

6. The inspection crew provides the CFE all required inspection reports and records (refer to Section 5.4, "Reporting," for reporting descriptions). The CFE reviews each report or record for accuracy including radiographic images for quality. The CFE assesses the data to determine if additional inspections are required. Reference Section 5.3, "Analyzing Data," for data assessment requirements. The CFE files each electronic report in the appropriate F:Drive PIT Program folder and files the hard copies into their appropriate Program Binder Files. The CFE archives all digital radiographic images in the appropriate F:Drive PIT Program folder.

   - The hard copies of records include: 1) isometric sketch of affected piping identifying applicable inspection site/grid; 2) *UT Calibration Field File Record* (Alyeska *Form 10299*); 3) RT Shot Log or Summary Sheet; 4) print out of Combo File; 5) print out of WinRSTRENG program calculation output; and 6) any supplemental reports, drawings, documentation, etc.

   - The hard copy documentation shall be positioned into the binders chronologically with the earliest performed inspections in the rear of the tabbed inspection site section and progressing in time to the front of each tabbed inspection site section.

   New electronic files (PIT Database), and hard copy files are created for baseline inspection grids. The CFE inputs inspection and corrosion information into the Pipe Integrity Testing (PIT) Report, CFE Checklist, Combo Files and RSTRENG Files. The CFE analyses of the inspection results, identifying any discrepancies or concerns. If there is apparent corrosion that is deemed significant or may warrant a safety concern, the CFE shall notify the IME and if necessary the appropriate facility personnel. Refer to Section 5.3 for data analysis.

7. The CFE ensures that site location photos contain the appropriate and necessary detail desired, then places them into the appropriate PIT Program corrosion photograph folder and Asset file in the F:Drive.

8. The CFE updates the CFE Checklist while work is being completed. This checklist is available in the F:Drive PIT Program folder. The CFE verifies each work site is returned to a safe operating condition and all inspection and labor work steps have been completed before moving to the next facility.

9. Reference Attachment 1, "PIT CID Manual," for details on PIT Database use.

5.2.3 NDT Technician Implementation Accountabilities

1. The NDT Technician examines all prepared inspection sites to determine if each location has been satisfactorily prepared and can be reliably tested. Report those sites requiring addition

preparation to the CFE. The CFE coordinates with the labor support crew to further prepare the site for inspection per Section 5.2.2, "CFE Implementation Accountabilities," Step 2.

2. The NDT Technician examines the subject inspection grid or corrosion location under the direction of the CFE and Implementation Package. The NDT Technician applies the appropriate technology to achieve the most accurate results. The NDT shall be performed in compliance with Alyeska-approved procedures and practices for each NDT discipline.
3. The NDT Technician documents the examinations and their results. The NDT Technician reports the results to the CFE in electronic format and hard copy format as applicable. The following reports are required (electronic and hard copy except film): UT Calibration Field File Record, hard copy color print A-B-C Scan Analysis Report-AUT, electronic .00a file, .00b file and/or .aly file, RT Shot Log and/or RT Summary Sheet, RT Densitometry Sheet, RT film or digital image, and any other NDE Reports or records of inspection as applicable. Upon completion of annual program, the NDT Technicians shall ship all RT film (if applicable) to the IME in approved shipping cases provided by the IME.
4. The NDT Technician digitally photographs each inspection location as directed by the CFE and routes them electronically to the CFE for review and archival.

5.3 Analyzing Data

The CFE and the IME both analyze the data. The CFE evaluates the data from the NDT Technicians. This involves reviewing the reports for accuracy and consistency and evaluating the results of the NDT, identifying potential corrosion related wall loss or other potential damage mechanisms. This also includes an evaluation for possible expansion of the grid limits. Once this is complete, the CFE inputs the data into their respective folders, PIT Report, and the PIT Database to begin processing the data. These steps are described in more detail below.

The IME reviews the PIT Report which has a line item for each inspection grid. Additionally, from the PIT Report the IME reviews each Combo File and RSTRENG file (as applicable; no Combo or RSTRENG for grids which received radiography only). Each file along with the PIT Report is cross referenced for accuracy and consistency. The CFE Checklist is also cross referenced to verify completion of all work to each inspection grid. These steps are identified and described in more detail below.

5.3.1 CFE Data Analysis Accountabilities

1. Upon receiving the reports and files for the NDT results from the NDT Technician, the CFE thoroughly reviews each document and file to assure their accuracy and consistency.
2. Radiographic information requires CFE review of the densitometry sheet and each piece of corresponding film or digital radiographic image. This review is to identify corrosion based upon the NDT Technician film interpretation results and when necessary (due to corrosion related wall loss or possible discrepancies with UT data), verification of results of densitometry.

3. For electronic UT data, the CFE transfers the .00a/.00b and/or .aly files into their respective inspection grid locations within the Combo File database folder. Each file is named according to its sequential inspection grid and naming convention. If the data is related to a baseline inspection, the CFE creates a new file. Each alpha numeric data set shall be positioned correctly in the Excel Combo File spread sheet to correctly correspond to the most recently previously acquired file (example: Row 001 on current grid shall line up with Row 001 for previous grid). Each alpha numeric data set (.00a/.00b and/or .aly file) shall be configured in its Excel format with "conditional formatting" with different colors representing varying degrees of wall loss. The CFE calculates wall losses to determine the conditional formatting color requirements. The CFE may manipulate the color percent and color scheme during their analysis to better suit the data set conditions, however, the final "saved" version shall follow the scheme identified below. Each Combo File shall be saved with its' conditional formatting intact. The percent wall loss and color scheme are as follows:

   a. **Red**: Represents wall loss equal to or greater than 20% of nominal or actual measured wall thickness.

   b. **Blue**: Represents wall loss from 10% to 19% of nominal or actual measured wall thickness.

   c. **Green:** Represents wall loss from 0% to 9% of nominal or actual measured wall thickness.

4. The CFE analyzes Combo File data and compares it against the most recent previously acquired data set looking for changes in the wall loss conditions represented by the data set, increased corrosion activity, corrosion trends, and any discrepancies in the data acquired. This includes determining whether grid expansion is necessary to capture any outlying data points to ensure adequate corrosion inspection coverage. The corrosion rate, whether baseline or interval, along with any corrosion percent increase is input into the PIT Report and applicable PIT Database location. Any discrepancies or suspect data points will be rescanned or reverified by manual UT to the satisfaction of the CFE.

5. Each Combo File data set acquired shall be compared arithmetically against the most recently acquired previous Combo File data set. The new alpha numeric Combo File shall be subtracted from the previously acquired alpha numeric file. The "difference data set" shall be placed to the right and adjacent to the new or current Combo File. The "greatest" difference point location value shall be identified and have a bold border placed around it for viewing. The corresponding alpha numeric grid point locations (example: F6) on each of the combo grids being evaluated shall be considered the current "grid point comparators." These values shall be input into the database as such for data analysis under the PIT Report. Additionally, the previous and new pit depths shall be compared and applied to the PIT Database to be part of the evaluation process. No conditional formatting is required for the comparator difference data set. The CFE shall save this for the IME evaluation of data. It will be the responsibility of the IME to delete once the final data reporting is complete. Should there be a difference in the physical size of the current and previous Combo Files, the difference comparison will be

the "best fit" size that best represents and incorporates the affected corrosion pattern represented by the conditional formatting of the Combo Files.

6. For locations with 20% wall loss or greater, the CFE creates a colorized 3D Corrosion Profile in Excel depicting the corrosion data set to help analyze the data. Place a hard copy of this 3D corrosion profile in the Binder file for the subject grid. The electronic version is saved along side of the applicable Combo File.

7. The CFE copies the "tNom/dPit"column (the far right depth of Pit column on each Combo File data set) into the Winrstr.exe program for pending half-life reinspection calculations per *ASME B31.4* or as applicable. The RSTRENG calculation utilizes the Maximum Allowable Operating Pressure (MAOP) to perform the required calculations. For *ASME B31.3,* "Process Piping" piping, a *B31G* "Manual for Determining the Remaining Strength of Corroded Pipelines," a Supplement to the ASME B31 Code for Pressure Piping calculation is performed directly under the PIT Database program.

8. Using the Windows RSTRENG calculation program (Winrstr.exe in the F:Drive PIT Program folder) or PIT Database B31G as applicable, the CFE inputs the required data into the header blocks, inputs the data string from the subject Combo File and run the RSTRENG calculation in the program. The CFE saves this RSTRENG data string into the RSTRENG data file in the F:Drive PIT Program, "RSTRENG" folder. The naming convention for this file follows the inspection site/grid naming convention.

   NOTE: Calculate a half-life re-inspection interval for each location that has received ultrasonic testing regardless of the inspection results. This could mean RSTRENG or B31G (for *ASME B31.3* piping). If it is determined that no corrosion related wall loss is exhibited, a standard 10 mil per year rate shall be used to perform the half-life calculation. This is completed in order to establish the re-inspection interval and acquire a safe maximum operating pressure.

9. The CFE transfers or inputs the results of the data review from the Combo File and RSTRENG calculation into the PIT Report and PIT Database location for each respective data entry cell and for each grid inspected, noting any relevant comments describing the corrosion found and/or conditions of inspection.

10. The CFE inputs the required information into the electronic Corrosion Investigation Report (CIR) within the Electronic Data Management (EDM) system. All locations identified for atmospheric corrosion evaluations will have a unique identification developed and an associated electronic CIR created. Comments shall be completed to support the EDM electronic CIR attributes and list the approximate length of piping system or component evaluated as applicable for each atmospheric corrosion evaluation site. The data entry of the *.00a*, *.00b* or *.aly* files are also be loaded into this system. When exposing belowground *ASME B31.4* crude oil piping, the CFE completes a Pipeline Investigation Report (PIR).

11. The CFE populates the CFE Checklist as appropriate to each inspection grid.

12. Reference Attachment 1, "PIT CID Manual," for details on PIT Database use.

5.3.2 IME Data Analysis Accountabilities

1. The IME reviews of each grid line item on the PIT Report. The IME notes the percent wall loss, maximum pit depth, interval inspection data (especially any increase in corrosion), MAOP or safe operating pressure calculated, RSTRENG or *B31G* reinspection date and comments. All data cells are reviewed with emphasis placed upon those identified here and any others found relevant to a specific grid finding.

2. Each Combo File is reviewed by the IME. This includes a cross reference check to the PIT Report verifying accuracy and consistency. Each Combo File data set is analyzed for the corrosion pattern, correlation to results of previous inspection data, minimum remaining wall (max pit depth and wall loss) and any apparent increase in corrosion activity. This evaluation will consider the grid point comparators as well as pit comparators. The short term corrosion rates will be identified and evaluated for reporting.

3. Each RSTRENG file is reviewed by the IME. This includes a cross reference check to the PIT Data Sheet verifying accuracy and consistency. Also cross reference check the RSTRENG file data string, max pit depth and nominal wall against the Combo File data verifying accuracy and consistency.

4. Review of the PIT Database for each line item grid inspected. The IME evaluates the PIT Database grid against the PIT Report, Combo Files and RSTRENG files verifying accuracy and consistency.

5. The IME evaluates the "pit corrosion increase" and "pit short term rate" as well as the "grid corrosion increase" and "grid short term rate" based upon the comparators as previously established and identified in the PIT Report (reference Section 3.0, "Definitions," for the appropriate equation format). Should either of these two comparator rates be greater than 10 mils per year (MPY) as used in the reinspection calculations then the IME will modify the reinspection interval in the PIT Database. The IME will input a Requested Inspection Date (RID) in the data entry page of the database for each affected grid. This RID will be developed based on the comparator short term rates. The IME will consider each comparator rate, remaining wall thickness, and current calculated reinspection date. Consideration will be made of the piping classification, product and whether it is DOT-jurisdictional piping.

   The IME will evaluate the remaining wall thickness against the greatest short term rate derived in the PIT Report if greater than 10 MPY. The number of years to achieve 80% wall loss will be calculated. Additionally the difference between the number of years calculated until the next inspection based on 10 MPY and the current inspection year will be determined and then divided by 2. The calendar year represented by the lesser of these two periods will be entered into the RID block of the database for the next inspection interval.

6. The IME verifies EDM data entry of all inspections as applicable, to include atmospheric corrosion evaluation locations.

7. The IME verifies through a review of the PIT Program drawings and PIT Report that the necessary evaluations have been performed for atmospheric corrosion control in accordance

with *49 CFR 192.479* and *49 CFR 192.481*, and *49 CFR 195.581* and *49 CFR 195.583* to represent each facility piping segment.

8. The IME verifies all required hard copy files are complete and incorporated into the Binder Files.
9. The IME reviews each grid line item in the CFE Checklist to verify SOW completion.
10. Reference Attachment 1, "PIT CID Manual" for details on PIT Database use.

5.4 Reporting

Reporting accountabilities are largely placed upon the IME. The NDE Technicians provide their reports and inspection records to the CFE and the CFE populates the PIT Database, PIT Program spread sheets and other applicable or required files as previously noted. The IME provides an interim report of the inspection results to each affected asset. The IME also completes the final reporting of the PIT Program results as required by *MP-166-1.00, Integrity Management Programs Process*, for the PIT Program Year-End Annual Report.

5.4.1 NDE Technician Reporting Accountabilities

1. No formal written report is required from the NDE Technicians for the PIT Program.
2. Refer to Section 5.2.3, "NDT Technician Implementation Accountabilities," paragraph 3 for the required NDE reports and records.
3. All data reporting shall accurately represent the actual data produced from the examination. No manual input, modification or rounding of values in ultrasonically acquired data shall be made unless authorized by the IME.

5.4.2 CFE Reporting Accountabilities

1. No formal written report is required by the CFE.
2. The CFE provides in e-mail format (or Word document attachment) an informal weekly summary of the work performed. This summary includes the following minimum information: the number of grids completed for the number of days being summarized; any technical; equipment or personnel issues experienced; any safety or environmental concerns; any grids identified with severe corrosion that warrant immediate attention or notification to the asset; a general over-view of areas inspected during that week and expected work to be completed during the up coming week. The CFE may include additional information as they deem necessary or relevant. This summary is meant to be one to two pages maximum. Tables or a spread sheet to present information is recommended.

5.4.3 IME Reporting Accountabilities

1. After data review, prepare a written report for each facility or Asset. These reports are in Word document format and are archived after submittal to the facility or Asset. These reports shall be clear and concise. The reports highlight the work completed and the results, listing in table format the grids deemed as actionable and the recommendations with associated MAC Actions or Issues. These reports are informal with respect to the PIT Program Year-End Annual Report and are separate from the year-end report. They should be written in a manner to quickly identify the work completed and the condition of the piping inspected.
2. The reports are referred to as "Interim Reports." The mainline valve locations are represented in the interim reports in accordance with their Asset (facility) area and are included in each Asset area report respectively. The VMT has one interim report written for Oil Movements and Storage (OM&S), Power Vapor (P/V), Marine and Ballast Water treatment (BWT), all inclusive.
3. The interim reports shall be written and formatted in a manner that best allows for future development of the PIT Program sections of the PIT Program Year-end Annual Report. The tables shall be created and populated to allow them to be cut-and-paste into the Pit Program Year-End Annual Report. The body of the interim report should also be written to accommodate as much cut-and-paste work into the Pit Program Year-End Annual Report.

   NOTE: The interim reports serve three basic functions: 1) to get the inspection results (i.e., the health and integrity of the systems) out to the facility or Asset personnel in as timely a manner as possible; 2) provide the IME a more rapid avenue to analyze, compile and report the inspection results from facility to facility in real time; and 3) provide the IME a foundation with which to write the PIT Program Year-End Annual Report without re-analyzing the program data.

4. The IME writes the PIT Program Year-End Annual Report pertaining to the PIT Program. This report is written to a prescribed format from a report template provided by the Integrity Management Supervisor. The IME reviews each interim report and all MAC Action items before starting the PIT Program Year-End Annual Report. The PIT Program Year-End Annual Report can be written by using the interim reports as the foundation for the information.
5. All reporting completed by the IME will specifically address all inspections grids completed that have exhibited a 20% wall loss or greater due to corrosion. Those grids not exhibiting this level of wall loss will be considered during the evaluation of data and will be processed for reinspection based on half life reinspection calculations, reinspection interval based on pipe segment, API re-inspection by class or risk depending on the data, product being carried in piping and location.

   For those inspection grids exhibiting a wall loss of 40% or greater, the IME will consider a recommendation for piping replacement. The consideration for material replacement should involve any of, or all of the following as applicable: short term rate (pit and grid point comparator), product in piping, possible inhibitor injections, location (high risk area, personnel exposure, environment, etc.), corrosion pattern/history, calculated safe maximum allowable operating pressure, calculated reinspection interval, consultation with Asset Owner Facility personnel. The IME shall also consider the possible recommendation for the application of a sleeve to the affected location using the factors noted above to aid in the decision process.

When piping is recommended and subsequently replaced based upon the IME reporting, reference *MP-166-3.03*, Facility Corrosion Integrity Monitoring, Section 5.2.4, "Piping Removed from Service," for the proper identification of the process to be followed.

6) The PIT Program Year-End Annual Report will provide a section to specifically address the evaluations completed for atmospheric corrosion control to describe the locations, number of evaluations and results of the evaluations for each facility.

6.0 Records

• UT/Pit Gage measurements (facility) • PIR (*Form 3619, Pipeline Investigation Report*) • Notification of allowable pressure below MOP, non-mainline • CIR (*Form 10002*, *Corrosion Investigation Report*) • FER (*Form 10009*, *Flange Examination Report*) • Copies of *Form 10299*, UT Calibration Field File Record • Radiographic film or digital images	All records generated as a result of this document will be retained in accordance with *CW-200, Records Retention Schedule*. All of these records are generated as a result of specifications *B-510*, *Mainline Pipe Investigation, B-511*, *Pump Station and Terminal Pipe Investigation Specification*, and *B-512*, *Pipeline Corrosion Evaluation Procedures*.

7.0 Revision History

Approved by Chuck Southerland, Engineering Integrity Management Supervisor		
Revision	**Date**	**Revision Summary**
3	05/20/10	Revision of Sections 1.0, 2.0 and 3.0 to explicitly specify adherence to atmospheric corrosion monitoring requirements in 49 CFR 192.481.
2	12/29/09	Performed scheduled review and updated document throughout.
1	04/29/08	Major rewrites throughout the document.
0	04/27/07	Initial publication of procedure.

Attachment 1. PIT CID Manual

PIT CID Manual

Last Revised 3/1/2007

Table of Contents

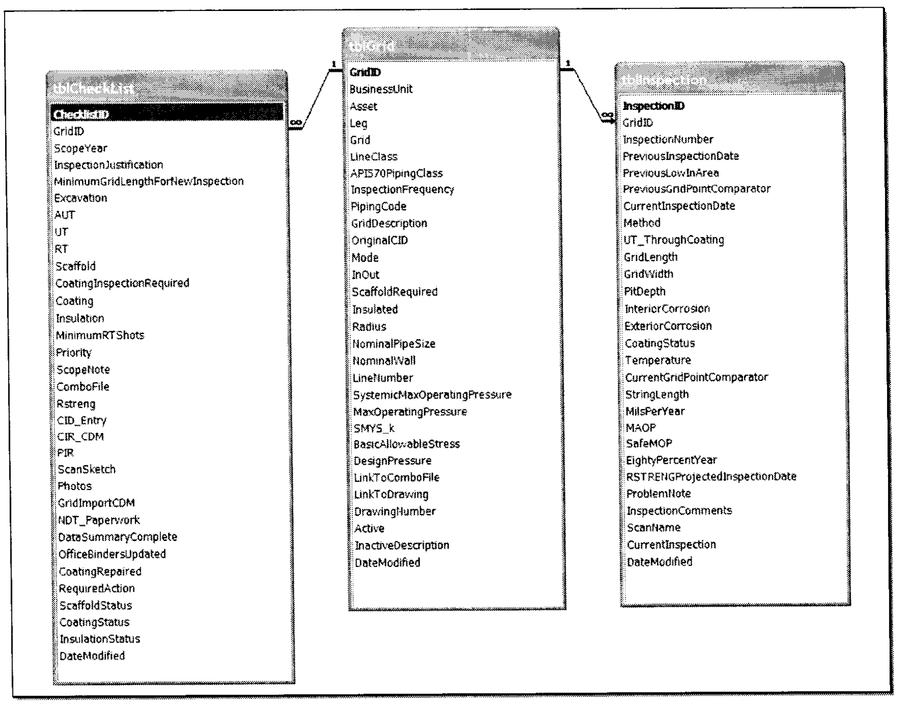
Installation

- This database uses Access replication, meaning that it can create copies of itself which can be synchronized. For more information about replication, see the section on Replication and Synchronization below.
- **Do not simply make copies of the database on the LAN**. Instead make a replica of the file PIT CID Tables.mdb.
    1. To do this, open PIT CID Tables.mdb and select Tools, Replication, Create Replica.
    2. Select a location for the replica. Ideally you will not move the replica once it is created, so this process should be done from the computer where you want to place the replica.
    3. Do not accept the default filename. Instead make the filename PIT CID Tables.mdb. (Code in PIT CID.mdb requires this filename.)
    4. If you wish, change the priority of the replica. See the section on Replication and Synchronization below.
    5. Click OK and say yes to all remaining messages. This process can take a few minutes, so be patient.
    6. Now that the PIT CID Tables.mdb is replicated, you can copy PIT CID.mdb from the LAN and paste it into the same directory as the replica you just made.
- You should never need to open the replica of PIT CID Tables.mdb that you just made. Instead, open PIT CID.mdb. The first time you do this, you may get a warning message. To eliminate this message, select Tools, Macro, Security and select Low.
- Each time you open PIT CID.mdb while connected to the LAN, you will be asked if you would like to synchronize the database. Synchronizing often is a good idea.
- Once you have created a replica of PIT CID Tables.mdb, do not move it.

Overview

- The database is comprised of two files: PIT CID.mdb and PIT CID Tables.mdb. This is called a front-end, back-end design where the front end is what the user sees and the back-end is where the data is actually stored. The front-end (PIT CID.mdb) provides a toolbar with the items you should use to view and edit the data.
- In this database, the data is separated into three conceptual units: grids, inspections and scope/status entries. There are three main tables in the database: the grid table, the inspection table and the checklist table.
- The grid table stores the location of the grid, what type of piping it is on and other things that don't change from inspection to inspection. In the old Excel version of the CID, this information was duplicated for each inspection and sometimes changed for no apparent reason. In the Access version of the CID, this information is only stored once.
- The inspection table stores inspection results, i.e. the information that could change when a grid is inspected. Each row in the inspection table is linked to one row in the grid table. If a grid has been inspected five times, there will be five rows in the inspection table that refer to one row in the grid table.
- The checklist table stores the scope of work and the completion status of each scope item, i.e. the checklist. In other words, the scope and the checklist are now one consolidated list. Each entry in the checklist table is linked to one entry in the grid table.

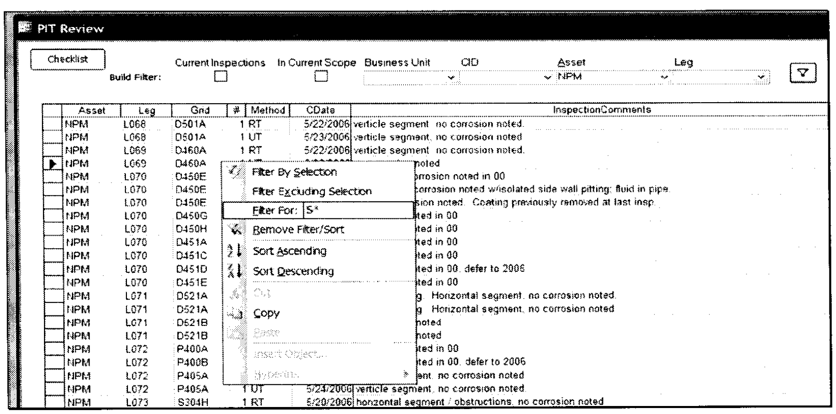
- The following screenshot shows these three tables and how they are linked together. Notice that they are linked through a field called GridID. This is a number that is automatically generated by the grid table. This is the primary key for the grid table (hence it is bold in the grid table). Access makes sure that no two records in the grid table have the same GridID, i.e. that the GridID entry uniquely identifies each record in the table. Checklist and Inspection records are linked to a grid through the GridID. For example, let's say that a grid at Pump Station 1 was given a GridID of 1234 and that it has been inspected three times. That means three records in the inspection table will have 1234 in their GridID field. If this grid is in the 2007 scope, there will be a record in the Checklist table with 1234 in the GridID field and 2007 in the ScopeYear field.



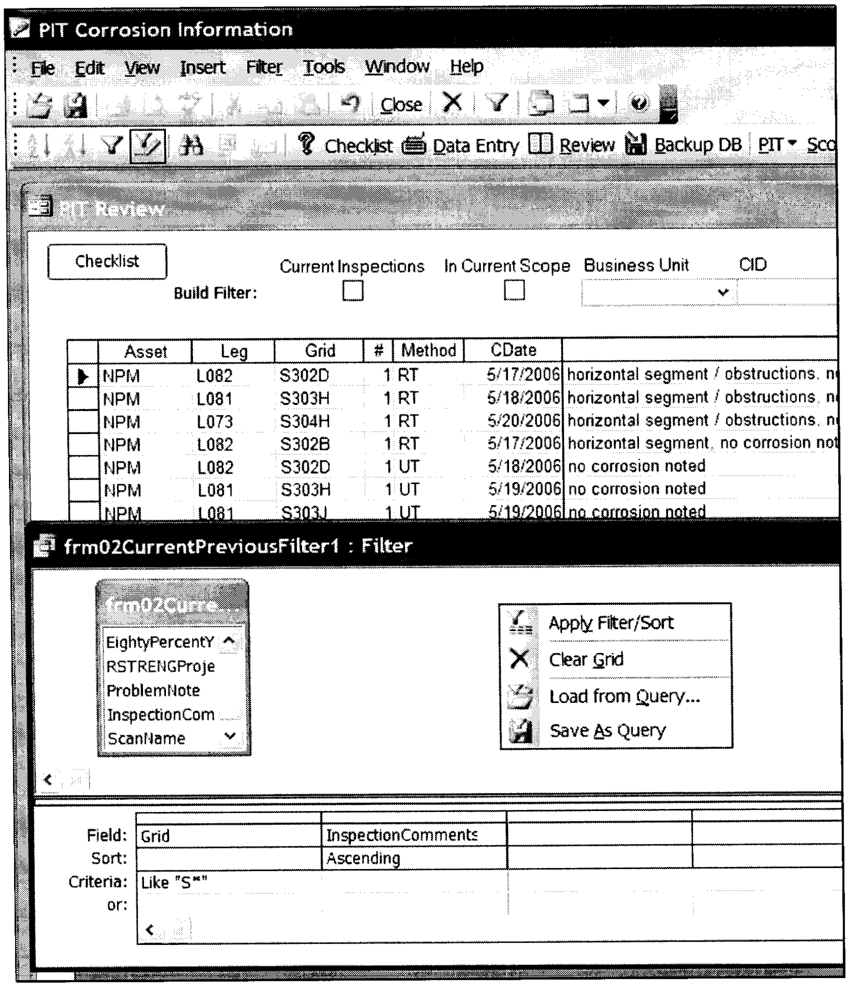
Using the Database

- There are two forms for viewing grid and inspection information. The Data Entry form shows grid information in one datasheet and inspection information in another datasheet. Moving through the list of grids changes the displayed inspection information. This form is designed for data entry. The Review form consolidates grid and inspection information onto one datasheet. It is most useful when you need to compare inspections between grids or when you need to search the entire database for something.
- The forms in the database typically display data in datasheet view, which is similar to a spreadsheet in Excel. You can change the column and row width much like in Excel. When you have arranged the datasheet how you want it, you can save (Ctrl-S) this layout so it appears the next time you open that form.
- You can change the order of columns by selecting the column and then dragging the column to where you want it.

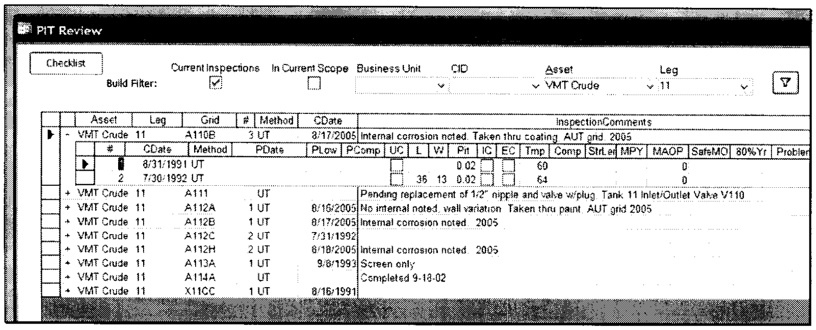
- You can hide columns by right clicking on the column and selecting hide from the popup menu. You can show and hide multiple columns by selecting Format, Unhide columns. This will open up a dialog box where you can select what columns you wish to see.
- One of the most important skills to learn is how to use sorting and filtering techniques to scan the entire database for the data you want to see. The two main forms (Data Entry and Review) have controls at the top that help you filter the data. However, you should learn how to use the standard filtering tools as well.
- The following screenshot shows the main filtering and sorting options. This menu is available by right-clicking any cell in the datasheet. In this example, I'm about to filter grid names for those that begin with the letter 'S'. Note however, that this will only show grids beginning with 'S' at NPM because the controls at the top of the form have already defined the filter for NPM. Keep in mind that filters are additive; the first filter restricts the data shown and each subsequent filter restricts the data further until the filters are removed.



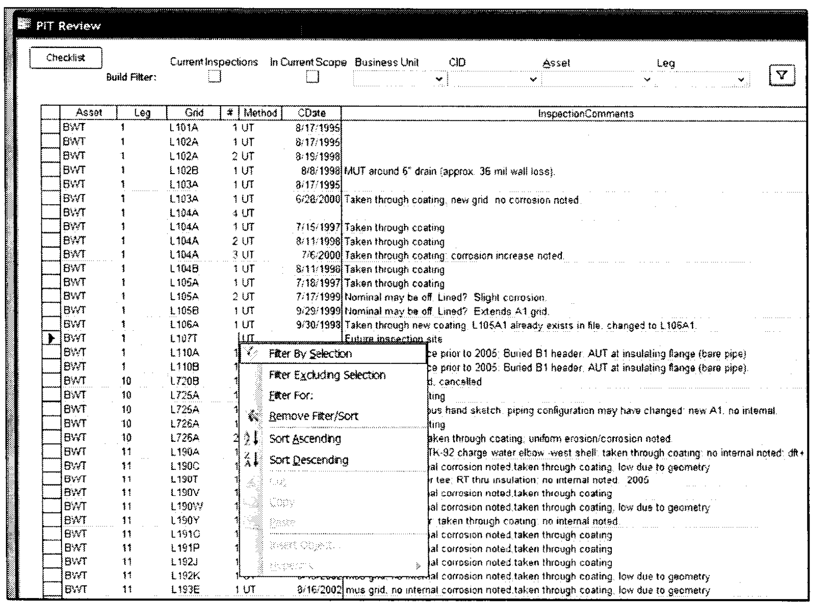
- You can sort by any column by right clicking on the column and selecting Sort Ascending or Sort Descending from the popup menu. You can sort by multiple columns by placing the columns side by side, selecting them and choosing one of the sort buttons on the toolbar.
- You can apply filters and sorts using the Advanced Filter/Sort button on the toolbar. These can then be saved for later use.



- The Data Entry and Review forms include a button with a key on it. This button is used to lock and unlock the form to editing. Although you can unlock the Review form for editing, you cannot add or delete entire records using this form. To add or delete records, you must use the Data Entry form.
- The Review form has a check box at the top called Current Inspections. When this box is checked, only the most recent inspections are visible. However, a plus sign appears to the left of each record and older inspections can be seen by clicking on the plus sign.



- You can use the Review form to search the entire database for something, say all inspections without an inspection number. (The Data Entry form cannot be used in this manner since it requires that you select a Business Unit and Asset.) Just remove all filters at the top of the form, find a blank inspection number and filter by selection.



- If you have the checklist open and want to find the inspection data for one of the displayed grids, you have two options depending on which form you use to view the inspection data. If you use the Data Entry form, you would select the Business Unit, Asset, and Leg from the controls at the top of the form and click the filter button. You can do the same thing using the Review form, but you could also copy the GridID from the checklist and paste it into the Filter For box. You could also use the Find function on the Edit menu.
- The checklist form displays checklist records and linked grid records. The grid data is locked so that you can't make changes to it through this form. When changes are made

to a checklist record, the form updates the field DateModified to the current date and time.

Items on the PIT Menu

Backup

- This item creates an on demand backup of PIT CID Tables.mdb and puts it in the backup sub-directory along with the daily backups.

Define New Front-End

- This item is used to help publish a new version of PIT CID.mdb. Let's say that you have modified your copy of PIT CID.mdb by adding a new report or changing the behavior of one of the forms and now you want to publish this so that everyone can get a copy. To do this, replace the LAN copy of PIT CID.mdb with your copy. Then open PIT CID.mdb on the LAN and select this menu item. It will update two fields: FrontEndVersion in the Variables table and LocalVersion in the Local Variables table. When a third party opens their copy of PIT CID.mdb and synchronizes, they will get a message saying that a new copy of PIT CID.mdb is available.

Sync

- Synchronize data with the Design Master version of PIT CID Tables.mdb on the LAN.

Grid Dictionary

- The grid dictionary is now a query and therefore is always up to date. It is available from the PIT menu and displays what asset each grid appears in and the most recent inspection date at each grid/asset.

Variables and Local Variables

- The Variables table is stored in PIT CID Tables.mdb and is therefore synchronized. One of the fields in this table is CurrentScopeYear. It is used throughout the database to determine what year of the scope to display. It is also used in calculations to determine when grids are due for inspection.
- The Local Variables table is stored in PIT CID.mdb and is not synchronized. The most important field in this table is DesignMasterPath. It defines where the design master version of PIT CID Tables.mdb is located. This should be on the LAN. All replicas of the database synchronize to this common location.

Defining Scope

- Each inspection record has a field called CurrentInspection. The DataEntry and Review forms set this flag so the database can easily find the most recent inspection data for each grid. This flag is very important since scoping is performed by reviewing current inspection data. If a grid has no current inspections, then it will not appear in the scoping queries. A query is provided to look for this case. It is under the Sanity Check menu and is called ToDo – Grids Without a Current Inspection. Make sure this query is empty before building the scope. You can also run some code to reset all the current inspection flags in the database and then look for errors; just select SanityChecks, Set All Current Inspection Flags.
- When all the data in the database is accurate, scoping is quite simple. However, at the moment, many older records need review before they can be considered accurate enough

to act upon. Those records are marked as Inactive. The scoping process ignores all grids marked Inactive. Until all the data is accurate, these inactive grids should be reviewed during the scoping process to determine if any should be reactivated and so included in the scoping process.

- There are two queries to help define the scope. The query Grids Due for Inspection only considers grids that are both active and current. So it is important to make sure that these two flags are correct throughout the database. The query Leg Due considers all grids and inspections regardless of the active and current status flags. It should be reviewed to ensure that the first query isn't missing anything important.

1. Define the current scope year. This is done by selecting the PIT menu and then Variables. The CurrentScopeYear field is used to calculate when a grid is due for inspection.
2. Review the database for accuracy by looking through all the sanity check queries and fixing any problems that you find.
3. Review the query Grids Due for Inspection from the Scoping menu. This query includes some formulas that use CurrentScopeYear to determine when subsequent inspections are due for each grid. These formulas should be reviewed annually to ensure that they implement the intended scoping rules provided by the client. Then the results of the query should be reviewed. When you are confident that the query is collecting only grids that are due for inspection, copy column GridID and paste it into the checklist. The checklist form will automatically set the ScopeYear to CurrentScopeYear.
   - You will probably get a message indicating that some records cannot be pasted because they would create duplicate entries. That is OK. We only want one copy of each grid anyway so Access is helping us out.
4. Add asset request grids using the Data Entry form. You can add a new grid and then click the button Checklist to add it to the checklist and then open the checklist. If you have more than one grid to add, you can click the check box to automatically add new grids to the checklist.
5. Print the scope report or export the Checklist to Excel.

Items on the Sanity Checks Menu

- TBD

Startup Code

Database Files

- The back-end file (PIT CID Tables.mdb) stores tables and relationships. This is where the data is stored, but you should rarely need to open this file. The front-end stores all the things you will use to access and modify the data: queries, forms and reports.
- It is important to understand one of the ways that a database is fundamentally different from a word processing or spreadsheet document. In those more familiar formats, there is little reason to separate how the data is stored from how it is viewed. That is not true for a relational database. The data is divided up and stored in tables, but we will rarely look at the data in that format. Instead, we will assemble the data into whatever format we need using queries, forms and reports.
- For us, the main advantage of separating the data (the back-end) from the way we access and use the data (the front-end) is that the database can be changed more easily than if these things were all in the same file. This design is also a basic requirement for databases that are accessed by multiple people at the same time.

- Because the data is stored in the back-end (PIT CID Tables), the front-end can be modified and replaced without changing the data itself.
- Unless you are modifying the design of the database, you should not open the back-end. You will normally open the front-end and use the items provided on the toolbar to work with the data. The forms and queries on the toolbar are designed to make working with the data easier and safer.

Replication and Synchronization

- The back-end part of this database is replicated, meaning that it can create copies of itself which can then be synchronized. The front-end is not replicated. The various copies of the back-end are called replicas. We have two kinds of replicas: a Design Master and global replicas. There can be only one Design Master for this database. The copy on the LAN should be the Design Master. Any changes made to the tables should be made to the Design Master. When global replicas sync with the Design Master, they will get any design changes that were made to the tables.
- ***Once the copy on the LAN is specified as the Design Master, it should not be renamed or moved or replaced by a global replica. This would destroy its status as a Design Master. This should be avoided.***
- If the Design Master is destroyed in some way, a global replica can be turned into a Design Master. See Access documentation for how to do this.
- Conflicts occur when two copies of the database modify the same field in the same record in different ways and then try to synchronize. (Note that this is called column level tracking as opposed to row level tracking. With row level tracking editing the same record produces a conflict even if the edit was to different fields on the record. With column level tracking the edit has to be to the same field of the same record for a conflict to occur. As a result, conflicts are rare with column level tracking.) When a conflict occurs the conflict resolution logic determines what happens. The following screenshot from Access Help describes this logic.

Microsoft Office Access Help

About setting replica priority (MDB)

Show All

Note The information in this topic applies only to a Microsoft Access database (.mdb).

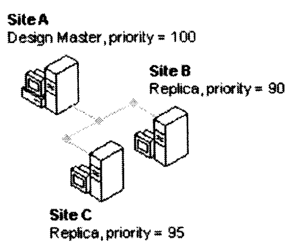
Replica priority affects how changes to records are resolved when there is a synchronization conflict.

Priority differences in different versions of Access

Determine replica priority

Every replica is assigned a priority number between 0 and 100, with 100 as the highest priority. When a database is made replicable, the replica's default priority is set to 90. Subsequent replicas have a default priority equal to 90 percent of the hub's priority. Priorities for local and anonymous replicas are always 0. Local and anonymous replicas automatically lose if their changes conflict with their global hub replica. If a local or anonymous replica sends a non-conflicting change to the hub, the hub assumes ownership of the change.

Microsoft Access carries the historical priority for each record in a replica set. During synchronization, the historical priority setting is evaluated and the record with the highest priority wins in any conflicts. To understand the priority scheme, consider the example of one Design Master, Replica A, with a priority of 100. Replica A replicates to two replicas, Replica B, which has a priority of 90, and Replica C, which has a priority of 95.

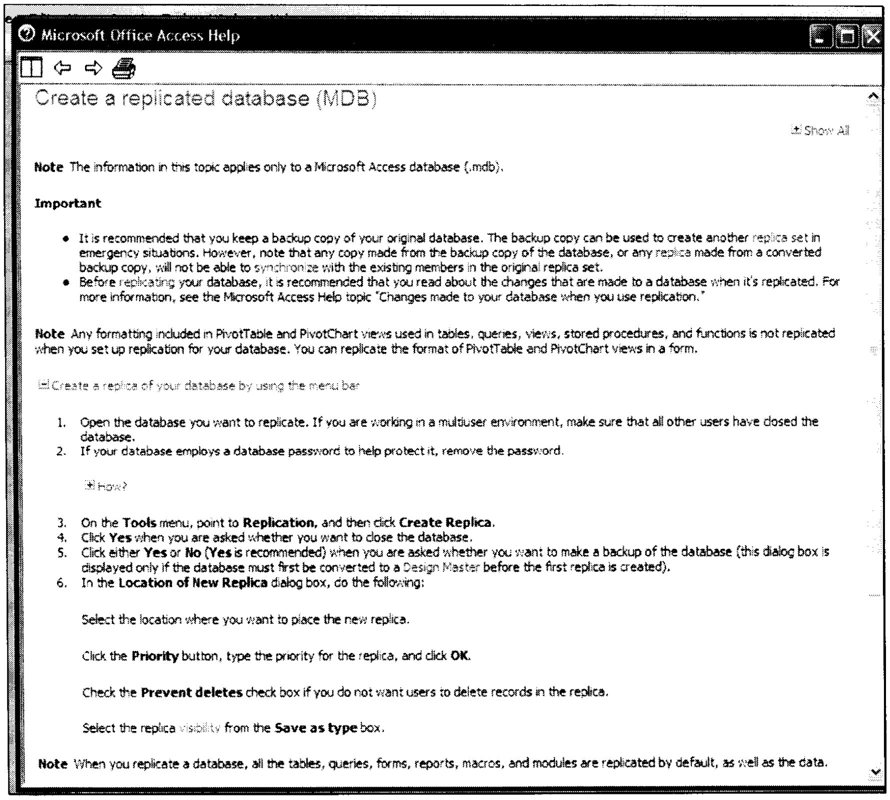


In a simple case, the highest priority change wins. Suppose that all three sites agree initially that Replica A created version one of the record, and no subsequent updates have occurred. If Replicas A and B update the record simultaneously, then Replica A's update is the conflict winner because it has the highest priority.

If multiple changes occurred to the same record after the last synchronization, then the replica that has changes with the highest historical priority is used to determine the conflict winner. For example, suppose that Replica A makes version two, and then sends it on to Replica B. Replica B makes version three, and then sends it back to Replica A, where it is merged. Then suppose that Replica C has also made a version two, and reconciles with Replica A. Choosing the highest historical priority of changes that occurred after the changes to the original record (Replica A with a replica priority 100 and 95 for the version of the row that Replica C has), Replica A and B's joint changes are the priority winner when compared to the change made by Replica C. However, because Replica A was created before Replica B, Replica A is the conflict winner. One benefit of this decision rule is that no changes made at the highest priority replica ever get reversed by the conflict resolution mechanism.

Was this information helpful?

- When you create another copy of the database, you get the chance to determine its replica priority. This priority determines which replica wins a conflict. See below for the Access Help instructions on creating a replica and defining its replica priority. If you wish, you can carefully make replicas with different priorities and let that logic resolve conflicts.



Microsoft Office Access Help

Create a replicated database (MDB)

Show All

Note The information in this topic applies only to a Microsoft Access database (.mdb).

Important

- It is recommended that you keep a backup copy of your original database. The backup copy can be used to create another replica set in emergency situations. However, note that any copy made from the backup copy of the database, or any replica made from a converted backup copy, will not be able to synchronize with the existing members in the original replica set.
- Before replicating your database, it is recommended that you read about the changes that are made to a database when it's replicated. For more information, see the Microsoft Access Help topic "Changes made to your database when you use replication."

Note Any formatting included in PivotTable and PivotChart views used in tables, queries, views, stored procedures, and functions is not replicated when you set up replication for your database. You can replicate the format of PivotTable and PivotChart views in a form.

Create a replica of your database by using the menu bar

1. Open the database you want to replicate. If you are working in a multiuser environment, make sure that all other users have closed the database.
2. If your database employs a database password to help protect it, remove the password.

   How?

3. On the **Tools** menu, point to **Replication**, and then click **Create Replica**.
4. Click **Yes** when you are asked whether you want to close the database.
5. Click either **Yes** or **No** (**Yes** is recommended) when you are asked whether you want to make a backup of the database (this dialog box is displayed only if the database must first be converted to a Design Master before the first replica is created).
6. In the **Location of New Replica** dialog box, do the following:

   Select the location where you want to place the new replica.

   Click the **Priority** button, type the priority for the replica, and click **OK**.

   Check the **Prevent deletes** check box if you do not want users to delete records in the replica.

   Select the replica visibility from the **Save as type** box.

Note When you replicate a database, all the tables, queries, forms, reports, macros, and modules are replicated by default, as well as the data.

- If two replicas have the same priority and a conflict occurs between them, you should use the Conflict Viewer to resolve them. This is available from the Tools, Replication menu.

Filenames and Passwords

- Do not change the filenames of either the front-end or the back-end. Code in the front-end assumes these filenames. You can, however, put these two files anywhere you want, as long as they remain in the same directory. The closer the files are to the root directory, the faster the database will operate.
- Once you create a replica of the back-end, do not move it.
- The front-end is password protected using the standard Access database password scheme available on the Tools menu. Use this menu to change the password for the front-end.
- The back-end cannot have a standard database password because it is replicated and replicas cannot be protected with a database password. Instead, the back-end includes a form that asks for a password. To change this password you will need to modify code in this form.

Backups

- The front-end includes some code that runs whenever the database is opened. This code automatically creates backups of the data (PIT CID Tables). One backup is created per day. Additional backups can be created by using a toolbar button.
- Backups are stored in a subdirectory called //BackupPITDB. The filenames include the date of the backup in YYMMDD format.
- You can specify the number of daily backups to keep. To modify the number of backups, select Variables from the PIT menu and modify the field MaxBackupCount. If there are more backups than MaxBackupCount, the oldest one will be deleted when the front-end is opened. (If you create backups with the toolbar button, you can have more backups than specified by MaxBackupCount. Each time you open the front-end, the oldest file will be deleted if there are more than MaxBackupCount.)

How the Data is Stored (Table Design)

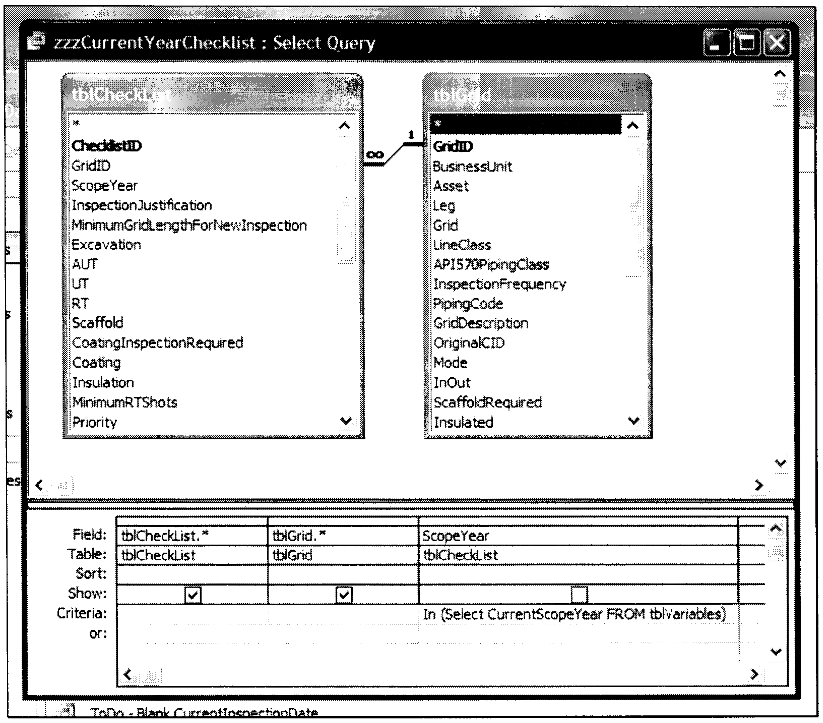
Tables, Records and Fields

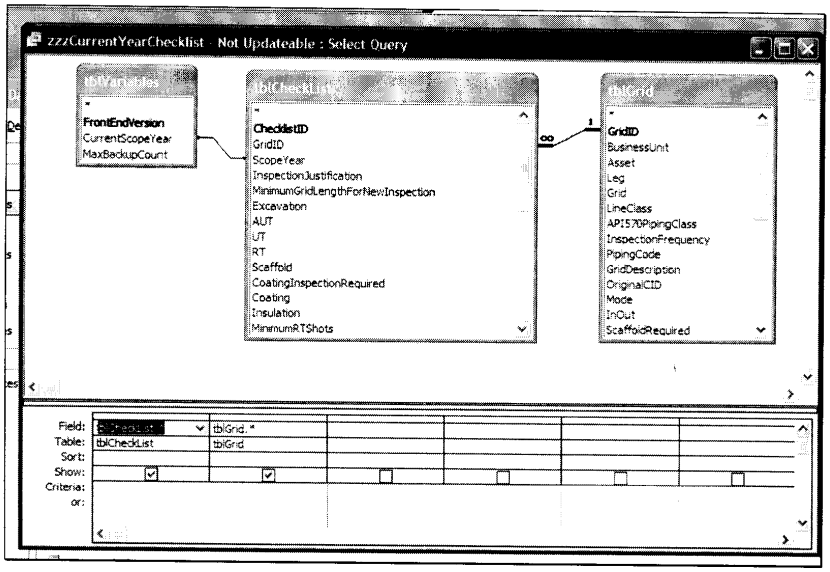
- The data is stored in several tables. The tables are in the file PIT CID Tables. A row in a table is called a record. Each column in a table is called a field. A field defines both the name of the column and the type of data that can be stored in it. For instance, some fields can only store integers while others can store decimals and others can store text. A field can also define the values permitted in it. For instance, it can define a combo box from which you can only select UT, RT or AUT. A table can also define what fields are required in each record. A new record cannot be added to the table until all the required fields are filled out. Each table has something called a primary key which can be used to uniquely identify each record in the table. (More on that later.)
- You can view the design of each table by opening PIT CID Tables, selecting a table and clicking Design on the toolbar. You may notice that some fields are a currency data type but obviously store decimal values. This is because the currency data type stores decimal values more accurately than the alternative data types.

How the Data is Viewed (Queries, Forms and Reports)

- By default, the database window is hidden. This is to encourage you to use the stuff on the toolbar. However, you can unhide the database window and gain full access to all the features Access provides. What follows is a brief description of how key elements of the database work. You don't need to know these things to use the toolbar items, but the information would be helpful if you wanted to change how the database works.
- You can unhide the database window by selecting Window, Unhide and clicking OK.
- The front-end of the database has four kinds of things: tables, queries, forms and reports. Most of the tables are just shortcuts to the back-end tables. Queries assemble data from the tables. They specify what fields and records to include in the query result. Forms are typically based on a query. The form displays the query results and provides tools for using the data. Changes to the data are usually made through a form. Reports are static views of the data much like a PDF is a static view of a document. Reports provide additional tools for formatting and displaying the data, but the data cannot be edited through a report.
- Queries that are used by a form are named after the form. Don't change these queries unless you intend to change the functioning of the form that uses it.
- Temporary queries that are saved as examples begin with zzz. These queries can be modified without changing the way forms and reports work.

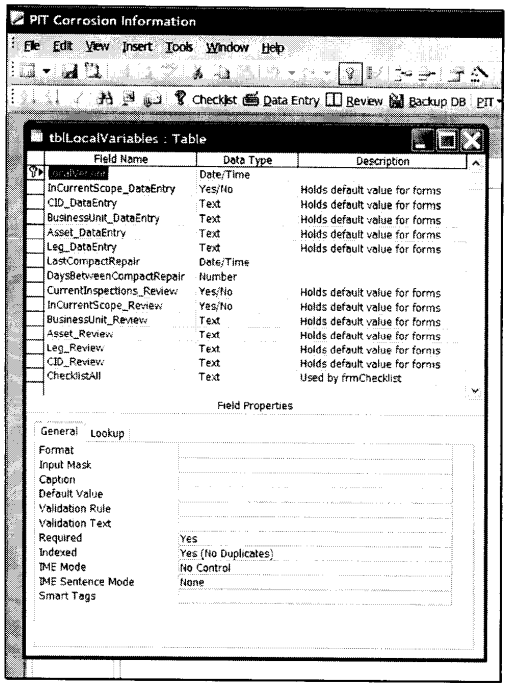
- If you start making or modifying queries, note that you should not filter to the current scope by entering a date in the criteria section. Instead, use a join or subquery as shown in the two examples below. If you type in a date to filter the data, it will need to be modified each year. If, however, you use one of the methods below, you will only have to update the CurrentScopeYear to update the entire database.





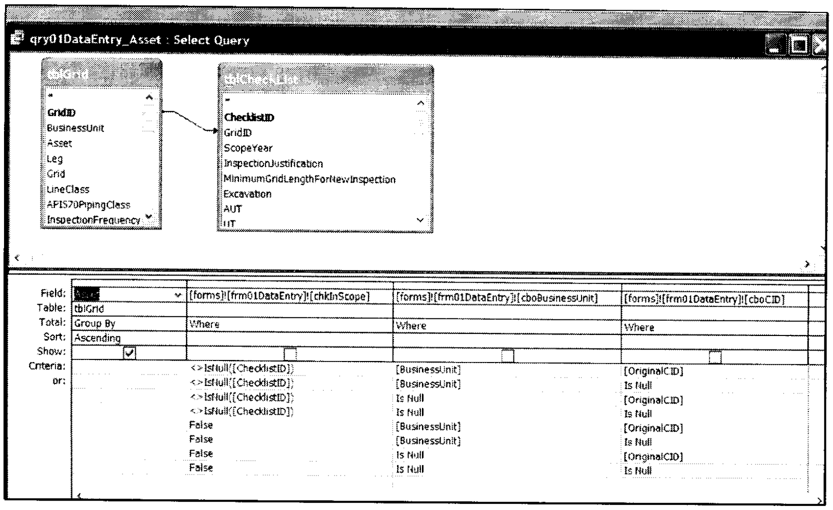
tblLocalVariables

- Unlike all the other tables, this one is stored in the front-end. Notice that it does not have a little shortcut arrow next to the table name. It stores the filters last used by the Data Entry and Review forms. It also stores how often the database should be compacted and repaired (a routine maintenance task) and when it was last done.



Form Filter Queries

- The two main forms—Data Entry and Review—have some controls at the top that provide a way to filter the data shown. These controls are fairly smart in that they display options based on the value of the controls to their left. For instance, the Leg combo box displays whatever legs are in the selected Asset. These controls get their data from queries that look at the controls to their left. These queries are very similar, so only one will be explained.



- This query is used by the Asset combo box on the Data Entry form. The query defines the list of Assets that you can choose. The controls to the left of this combo box are In Scope check box, the Business Unit combo box and the CID combo box. The query uses the values of those controls to filter the list of all assets to just those assets that you want. For instance, if the In Scope check box is selected, the list will be filtered to include only Assets that are in the current scope.

Code to Determine Current Inspections

- This database uses the CurrentInspection field in the inspection table to determine what inspections are the most current. This field is set by some code that reviews all the inspections for the subject grid and determines which one should be flagged. This code is run when you modify, add or delete an inspection with the DataEntry form. It is also run when you modify a record with the Review form. (You can't add or delete records with the review form.) If you change an inspection record without using the Data Entry or Review forms the CurrentInspection field could be incorrect. You can run this code on all grids by selecting Sanity Checks, Set All Current Inspection Flags.
- This code can be seen by opening the front-end, and selecting Tools, Macro, Visual Basic Editor (or Alt+F11). Then select Modules, Module1, SetCurrentInspection(). It would be a good idea to read through this procedure and learn how it works.