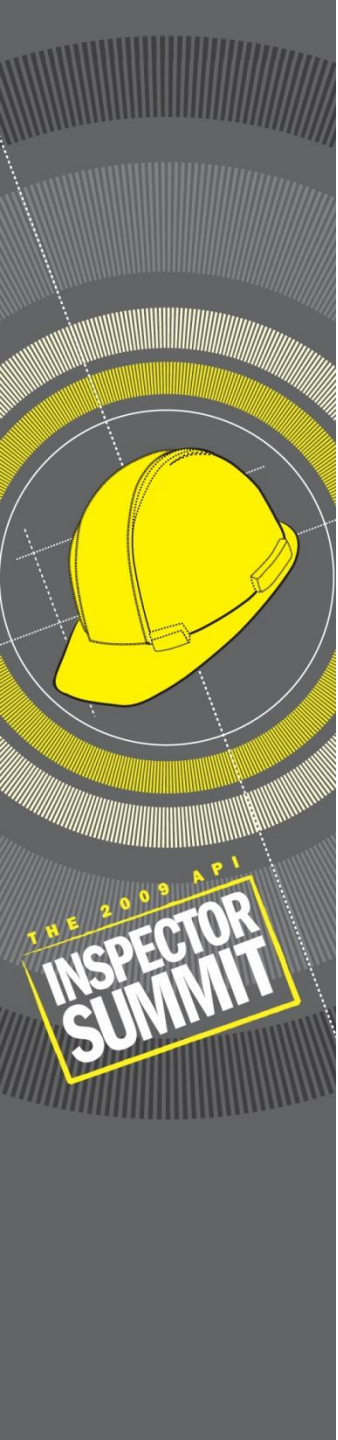


# Fire Damage Inspections for Fitness-for-Service

Joe Frey P.E.



# Background

- Power Industry since 1980
- Joined SES in 2004
- ASME B31 Code Committees
- Emergency Response / FFS
- Five Fires – 2 years





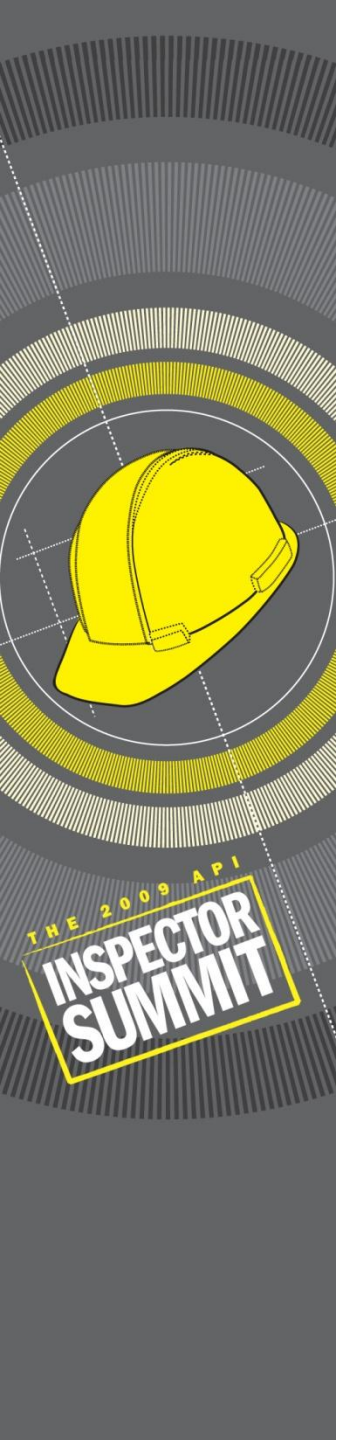


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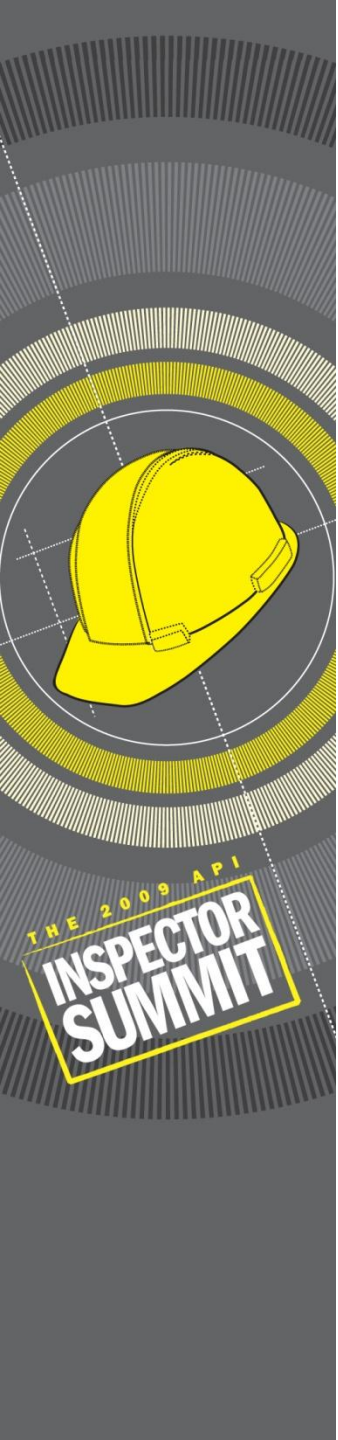
# Fire Assessment FFS

“Most ‘messed’ up job I have  
ever been on”



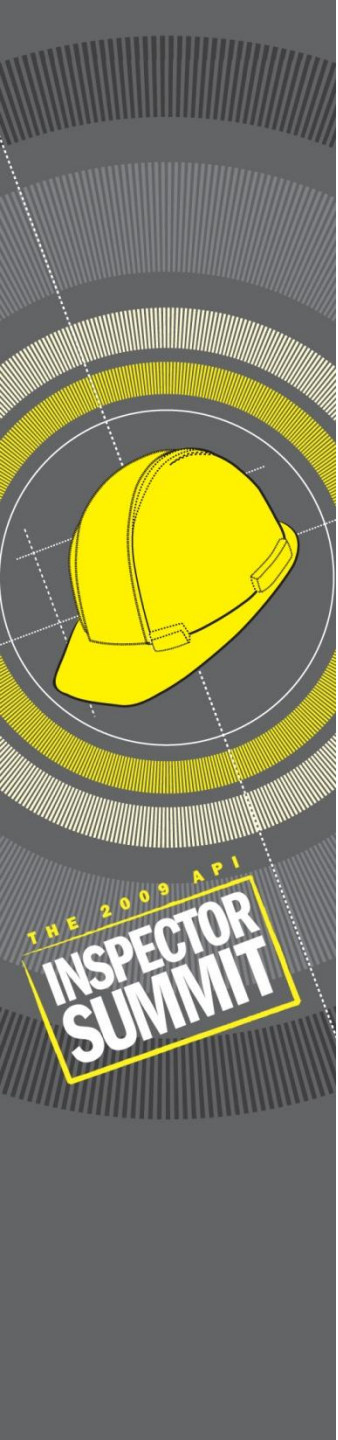
# Today's Presentation

- Purpose – To outline an approach & relate consistent observations about fire assessment FFS efforts:
  - To inform those with out fire assessment experience.
  - For those with experience – group therapy.



# Outline

1. Preparation
2. Event
3. Investigation
4. FFS Evaluation



# OSHA 1910

1910.119(j) Mechanical integrity.

1910.119(j)(2) Written procedures.  
The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment.



# OSHA 1910

1910.119(o)(1) Employers shall certify that they have evaluated compliance with the provisions of this section at least **every three years** to verify that the procedures and practices developed under the standard are adequate and are being followed.



# Being prepared means having:

OSHA 1910.119 (j) and (o)

Equipment Drawings

Equipment Design Information

Equipment Operating History

Mechanical Integrity Inspection Findings



# Operating Life History

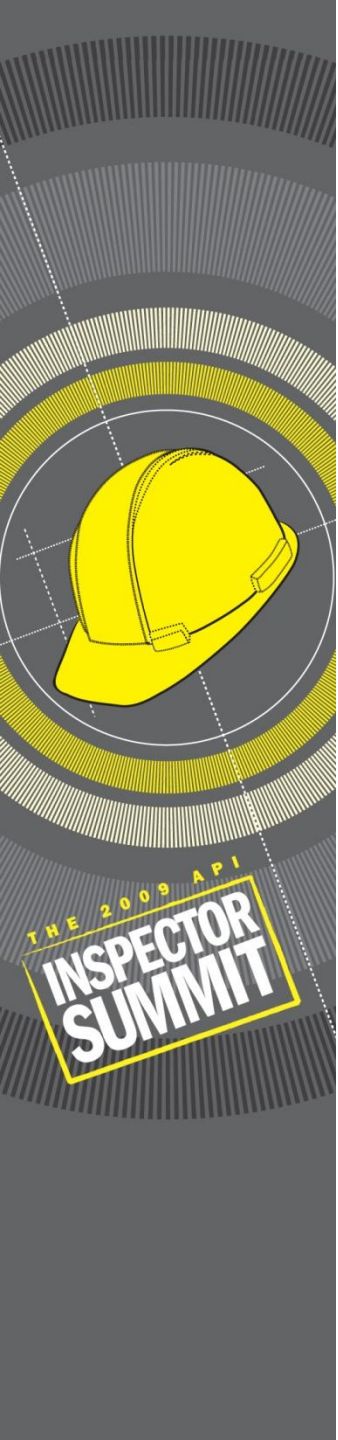
Was the vessel originally used in another service?

Was it modified?

If so, when and by whom?

How has the equipment been used to date?

How will it be used from this date forward?

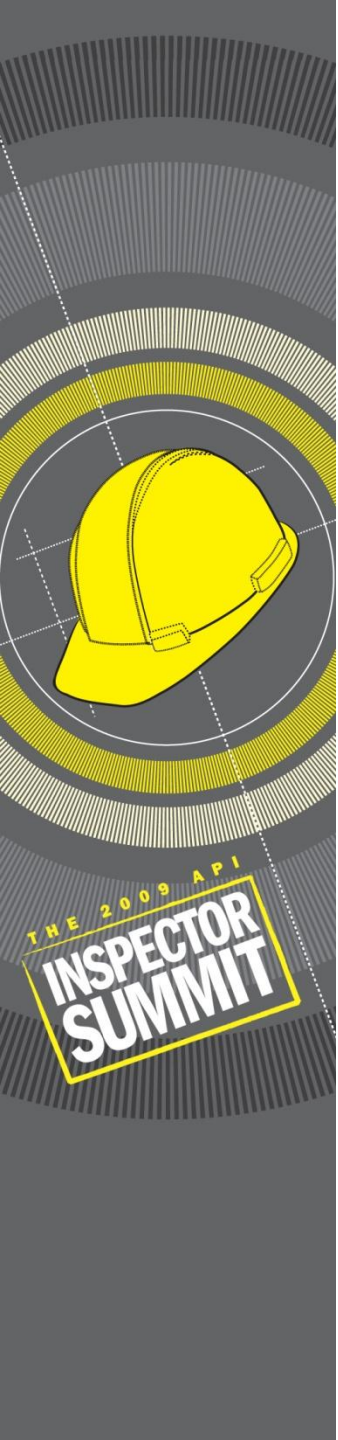


# Inspection history

For piping and vessels:

- Repair History
- Results of last inspection

Details, not just “OK”







**Be Prepared, Because  
Once the Catastrophic  
Event Occurs....**



# Suddenly and without warning

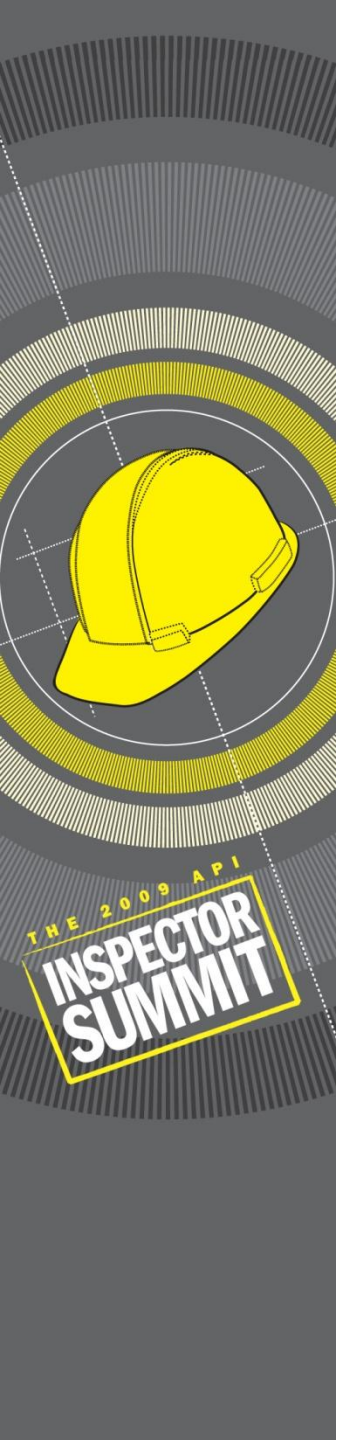
No one plans to have a catastrophic event that day.

“Like a thief in the night”.

Do you know where your records are?

Do you know what is in them?

Do you know the condition of your condition?





# Emergency Response

Emergency Response teams will address the hazards

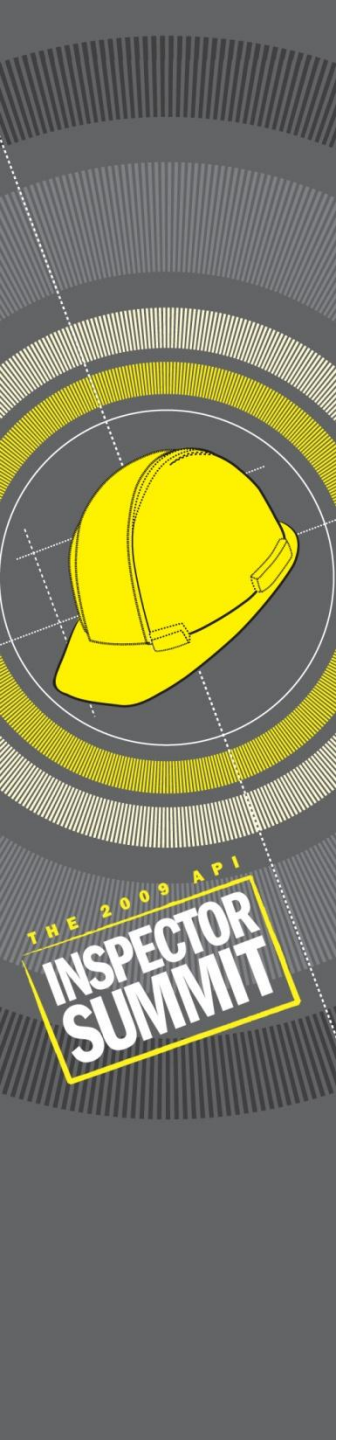
Put out the fire

Contain the leak

Tend to the injured

Make the site safe for inspection

Then what?



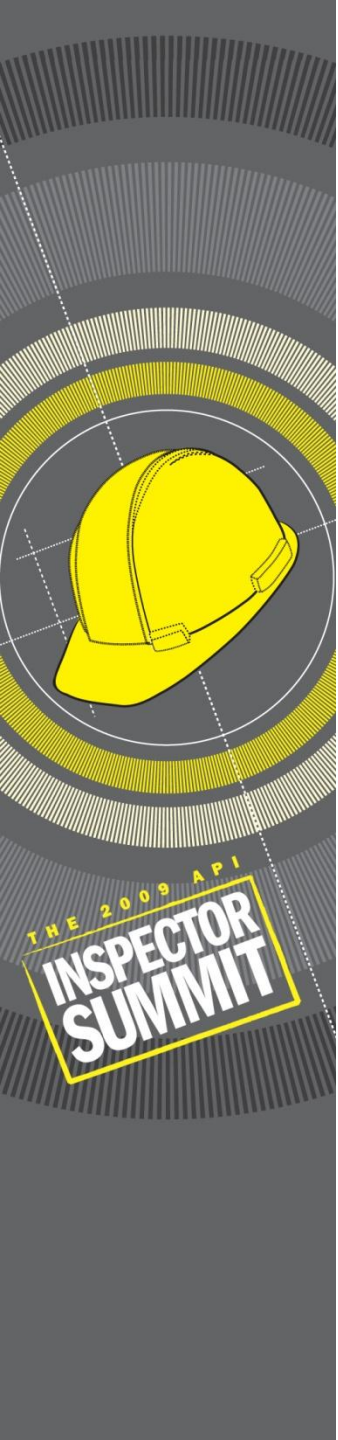
GOOD  
USED  
Refinery

EBAY  
#3854692

FOR  
SALE  
CHEAP!!

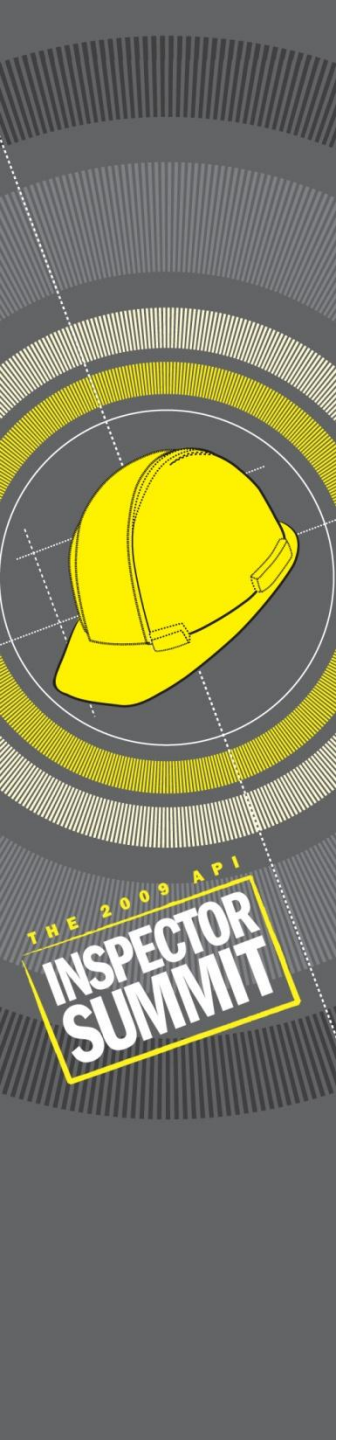
# Site Secured

- Chemical Safety Board (CSB) will arrive.
- OSHA will arrive.
- Root Cause Investigation team will arrive.
- Access will be limited.
- Preliminary assessments will be performed.
- Inspection companies will be lining up inspectors.



# Immediately

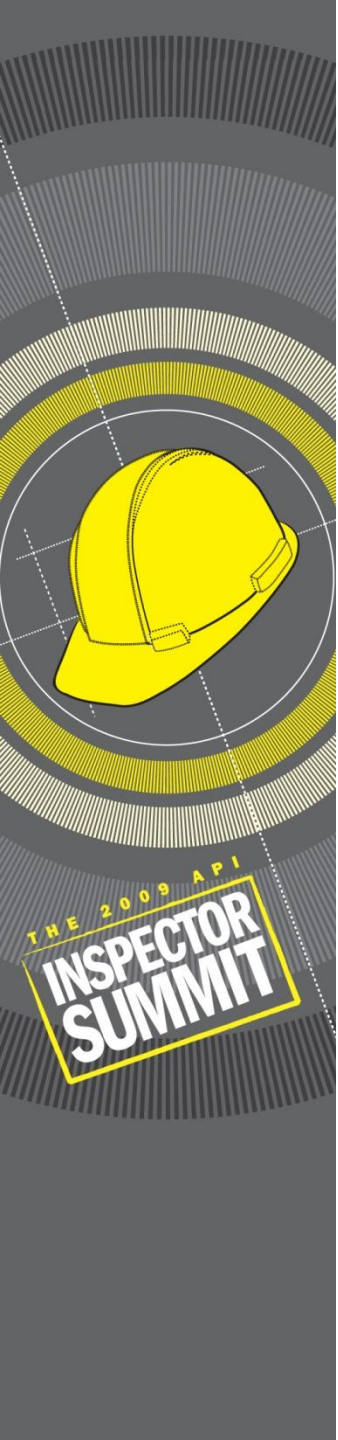
Resident employees will be hit with questions and requests for information and will not see home but for a few hours a day for weeks to maybe months.



# Immediately

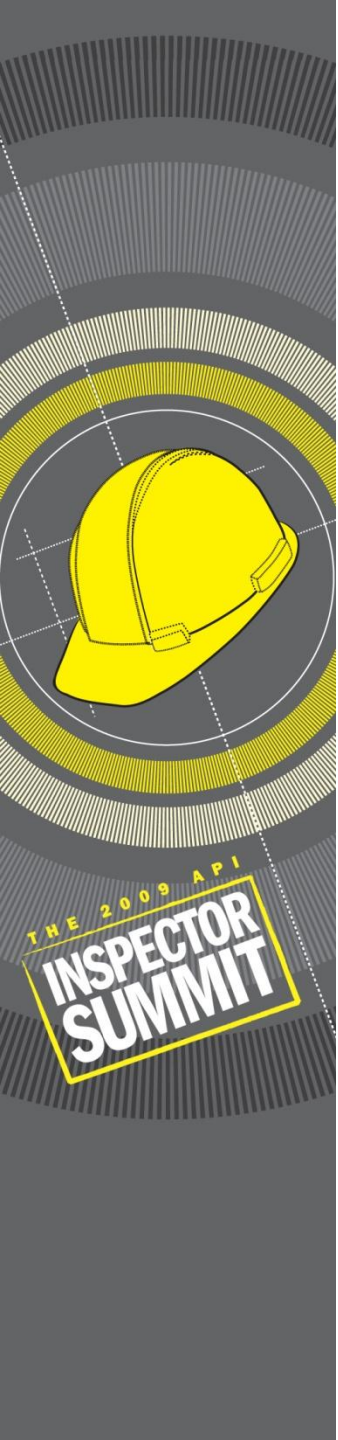
Leaders will be selected to lead certain efforts:

- Clean up
- Partial production
- Investigation
- Assessment / Rebuild



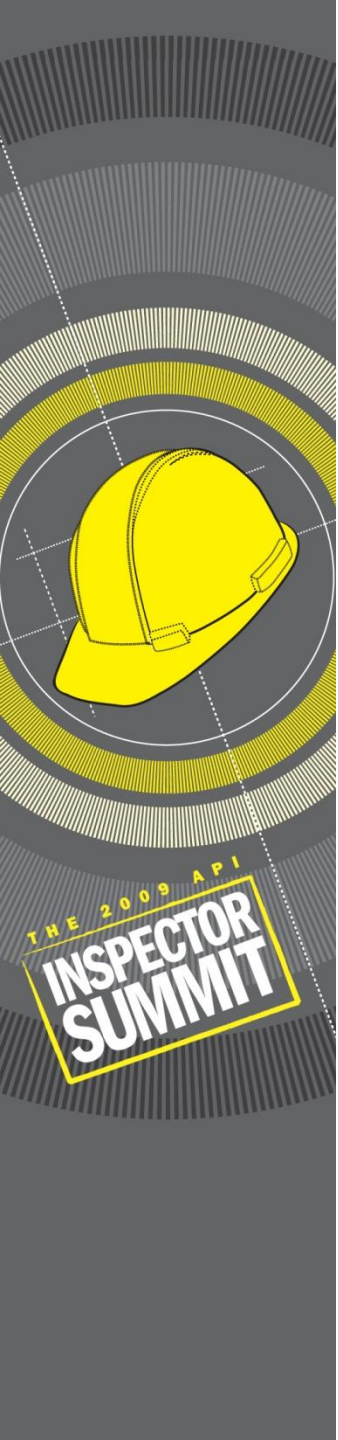
# Fire Assessment FFS

- Pressure Vessels
- Piping
- Valves
- Structures
- Supports
- Concrete
- API 579+



# API 597 Chapter 11

- Determine Fire Zones
- Protocol for Determining FFS
- Does not address structural steel and concrete



# API RP 579

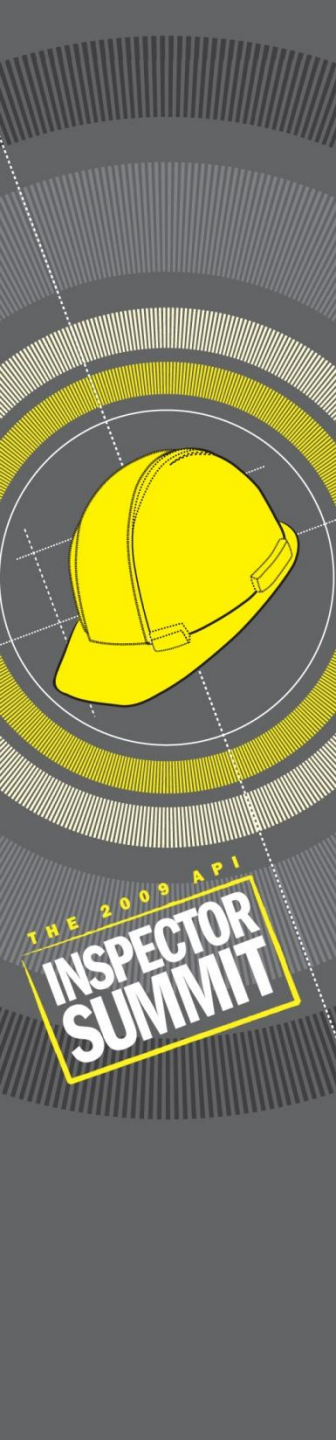
## Fire Exposure Zones

**Zone 1** No effects

**Zone 2** To 150°F, smoke and water exposure

**Zone 3** 150–400°F, light heat exposure

**Zone 4** 400–800°F, moderate heat exposure



# API RP 579

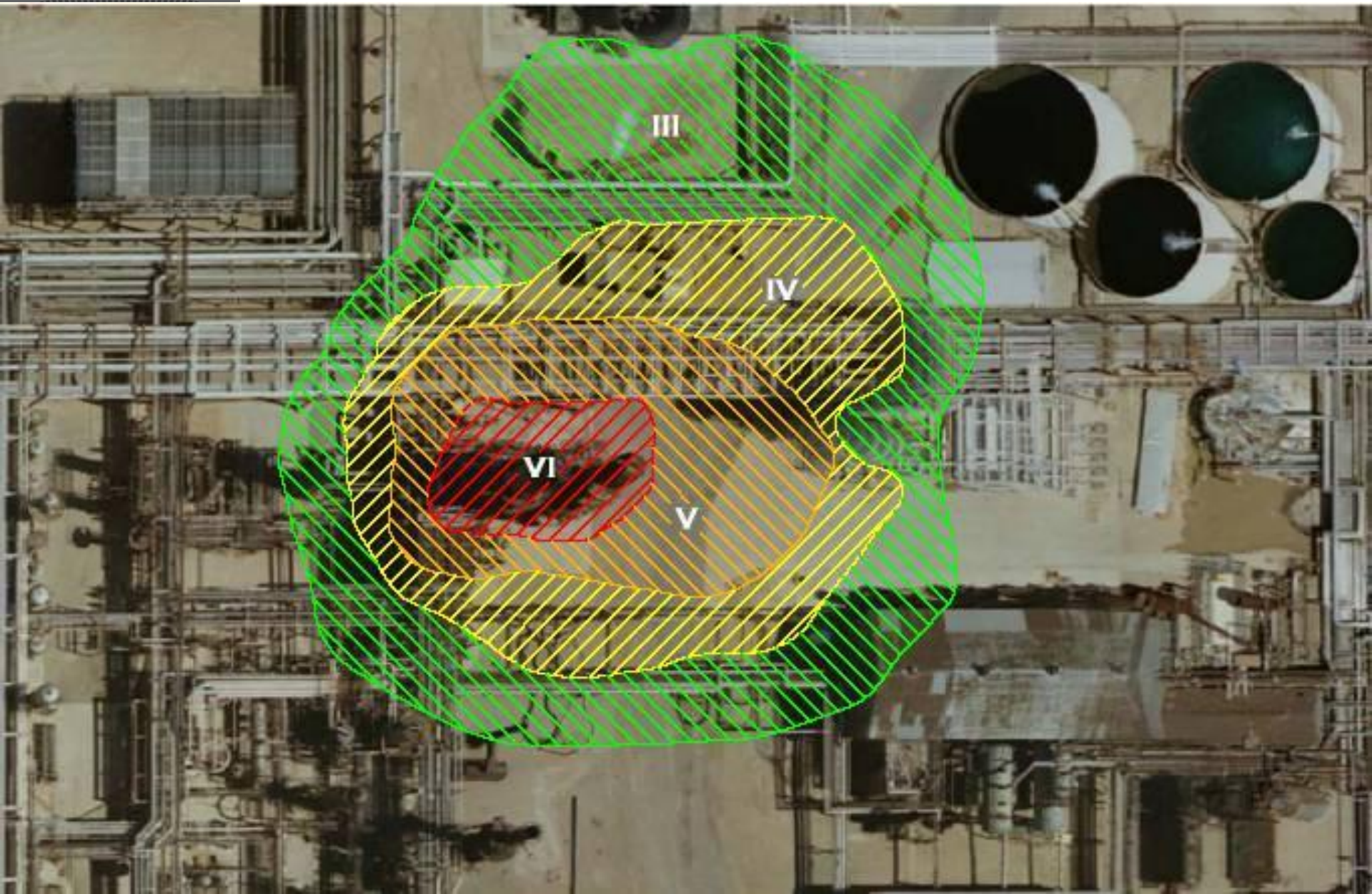
## Fire Exposure Zones (cont'd)

**Zone 5** 800–1350°F, direct flame exposure, but no impingement. Heavy heat exposure.

**Zone 6** Over 1350°F, direct flames and impingement. Severe heat exposure.









IV

V

VI

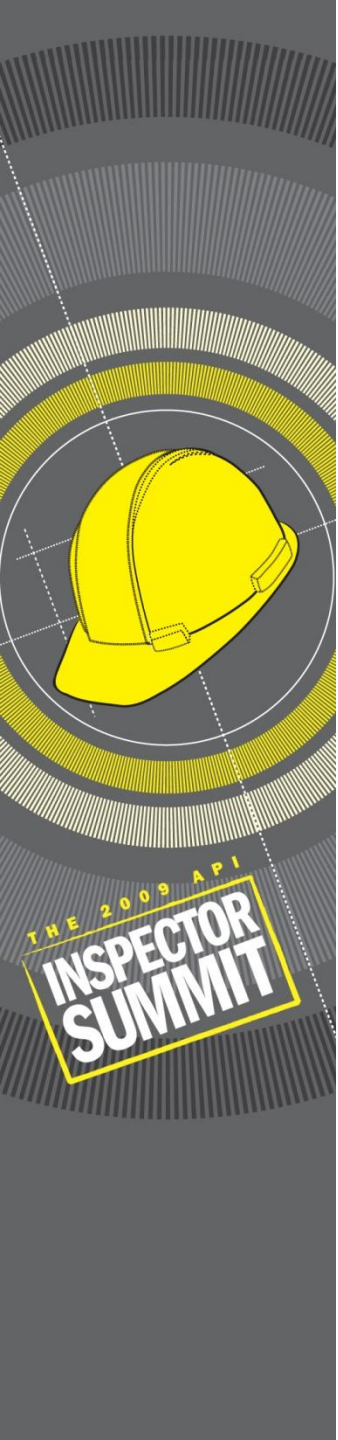


VI

V

# Tailor Assessment and NDE to Heat Zones

Develop specific inspection plan for each component subject to fire damage. Defined by heat zone number.



# Heat Exposure Zones I, II, III

Perform agreed upon / necessary NDE and a Level 1 Assessment.

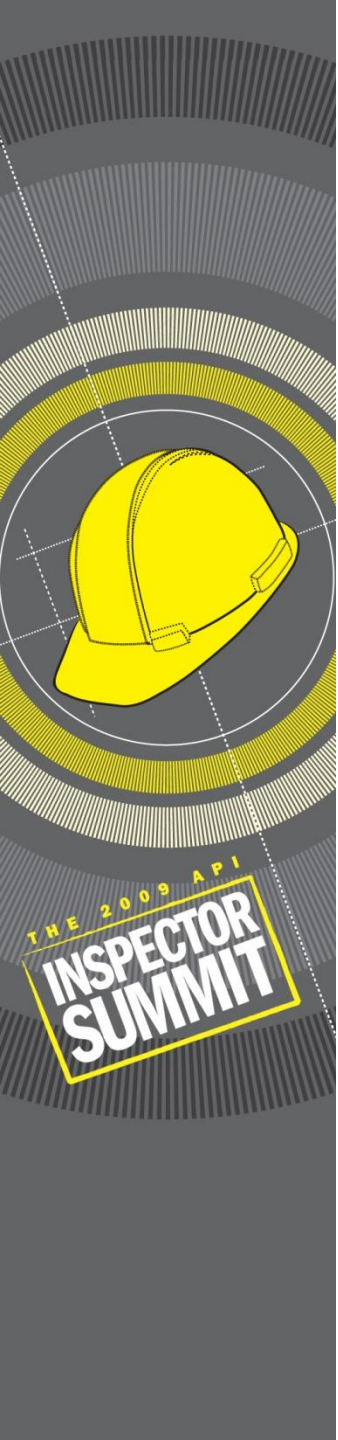
Perform Level II Assessment for components that do not pass a Level I Assessment, when cost justified.



# Heat Exposure Zones IV and V.

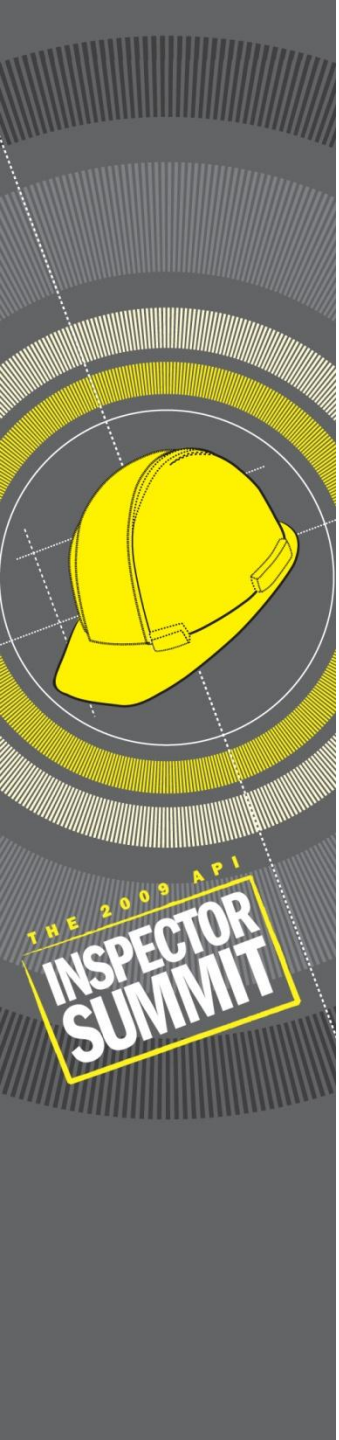
Perform agreed upon / necessary NDE a Level II Assessment.

Perform a Level III Assessment for components that do not pass a Level II Assessment, when cost justified.



# Heat Exposure Zone VI.

Perform agreed upon /  
necessary NDE a Level III  
Assessment, when cost  
justified.



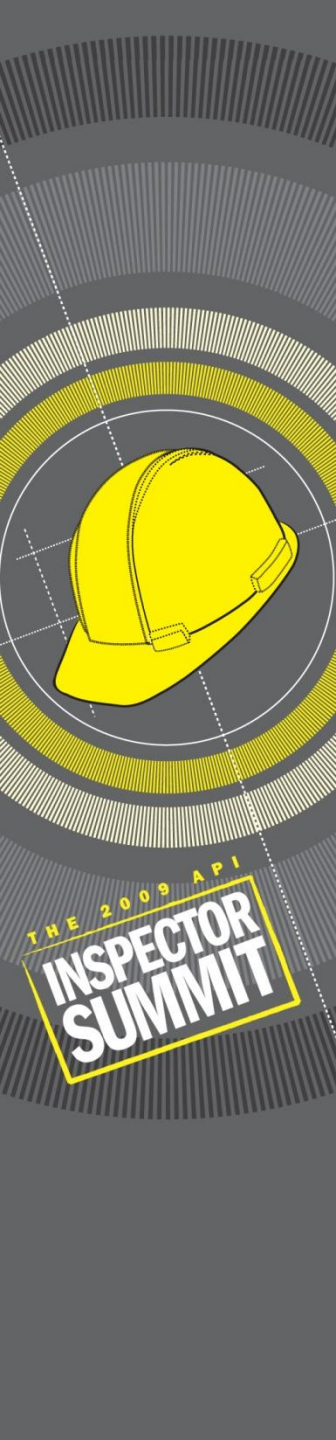
# Types of Inspection

External / Internal Visual Inspection

Diametrical & Circumferential  
Variations of Cylindrical Vessels

Straightness of Shell & Piping  
Sections

Vertical Plumb Measurements

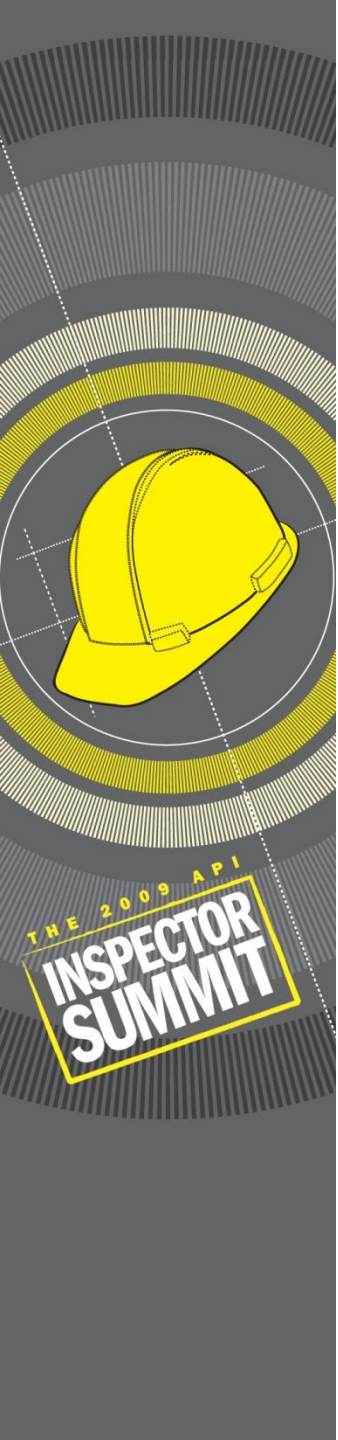


# Types of Inspection

Hardness Test of the Base Material  
& Welds

Wall Thickness Measurements of  
Press. Containing Components

In-Situ Metallography & Micro  
Structure Replication

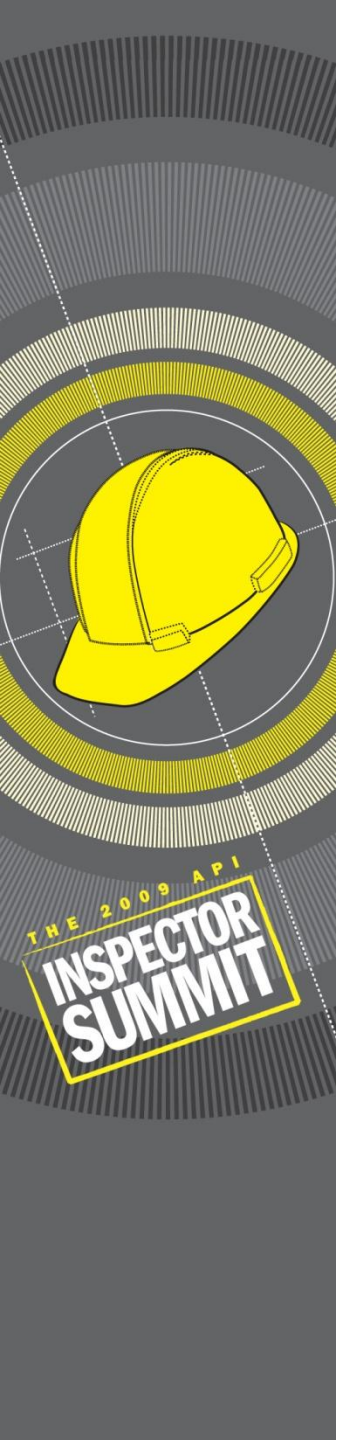


# Types of Testing

Removal of Coupons for Mechanical Testing

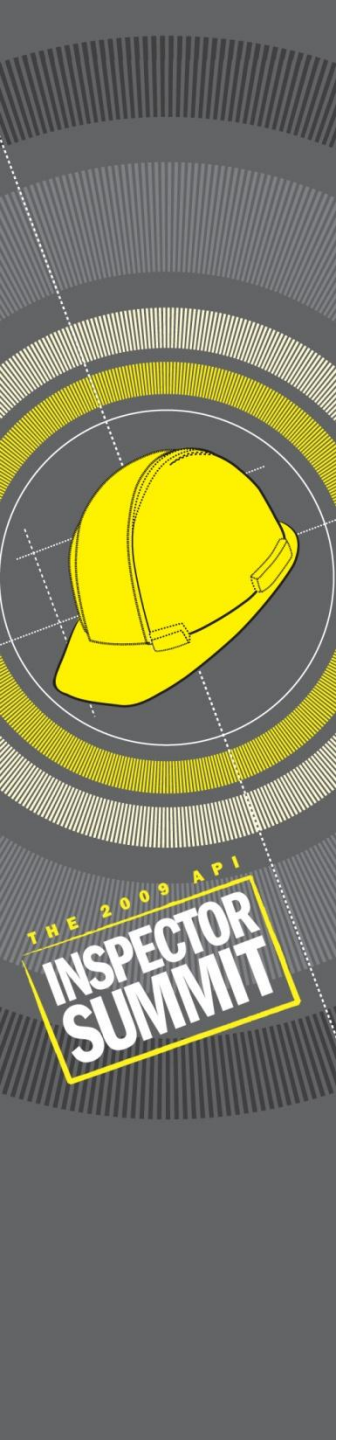
Surface Crack Detection Techniques

Hydrostatic Test



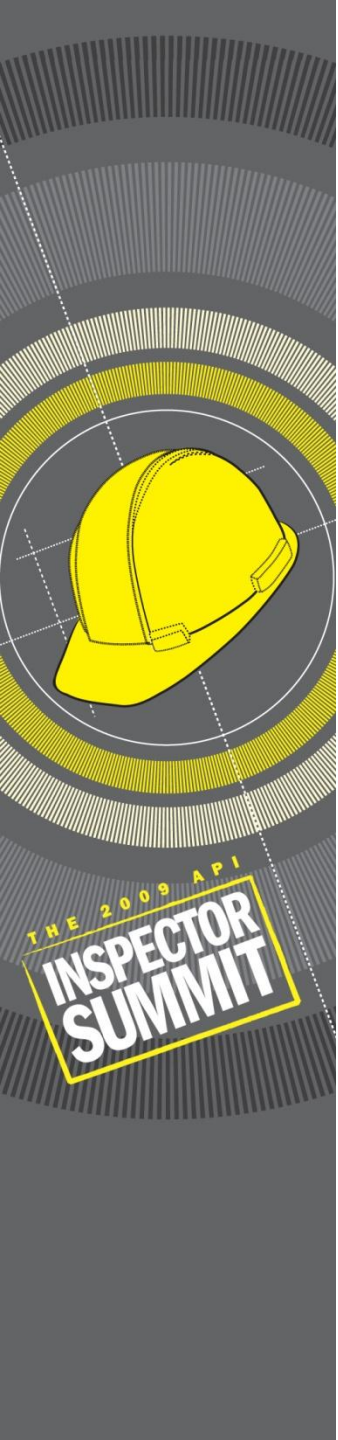
# Piping

- Point and cut, OR evaluate
- Surface inspection
- Hardness at cut point



# Foundations & Steel

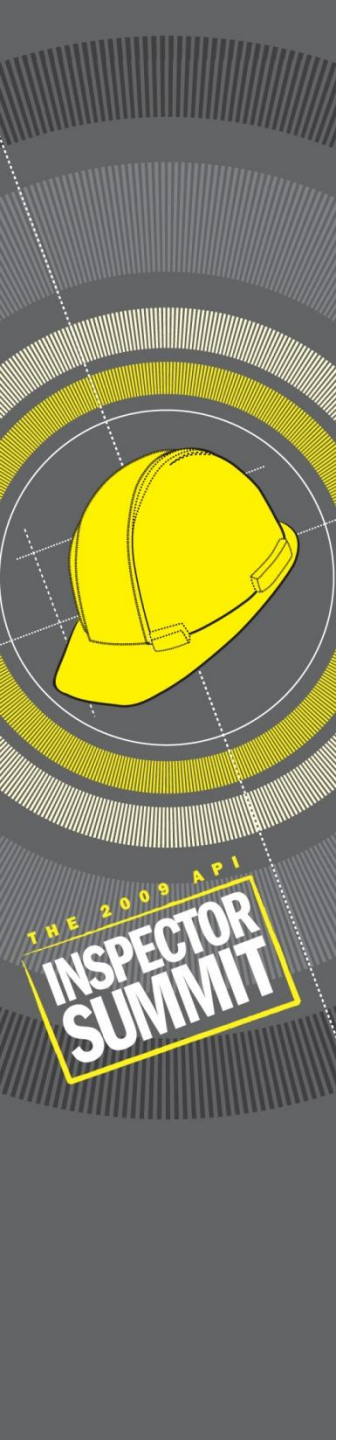
- Determine extent of damage
- Use construction tolerances
- Perform Level III Assessment on steel, if cost justified





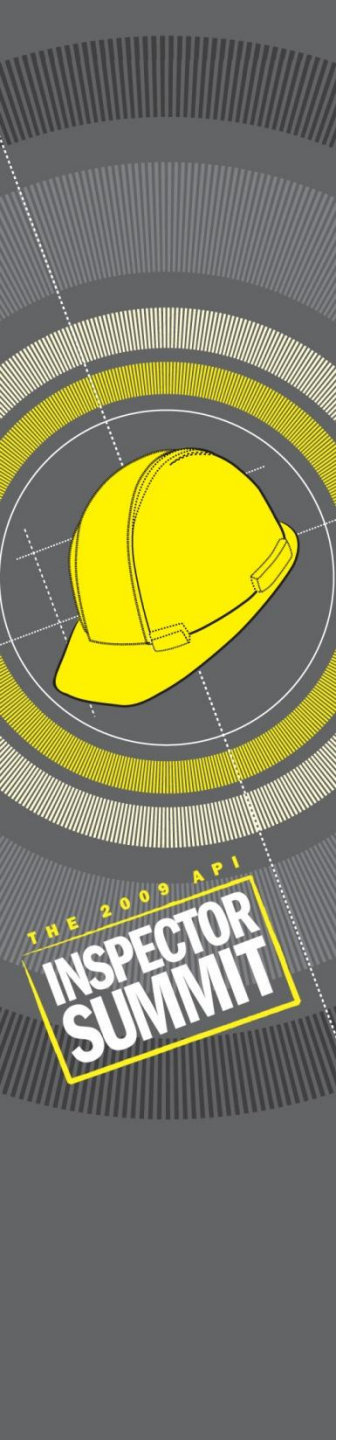
# Exchangers

- Surface inspection
- Hardness
- Wall thickness
- Sagging
- Metallurgical evaluation



# Towers

- Check plumb and bulges
- Surface inspection
- Hardness
- Metallurgical evaluation
- Laser scan camera and FEA



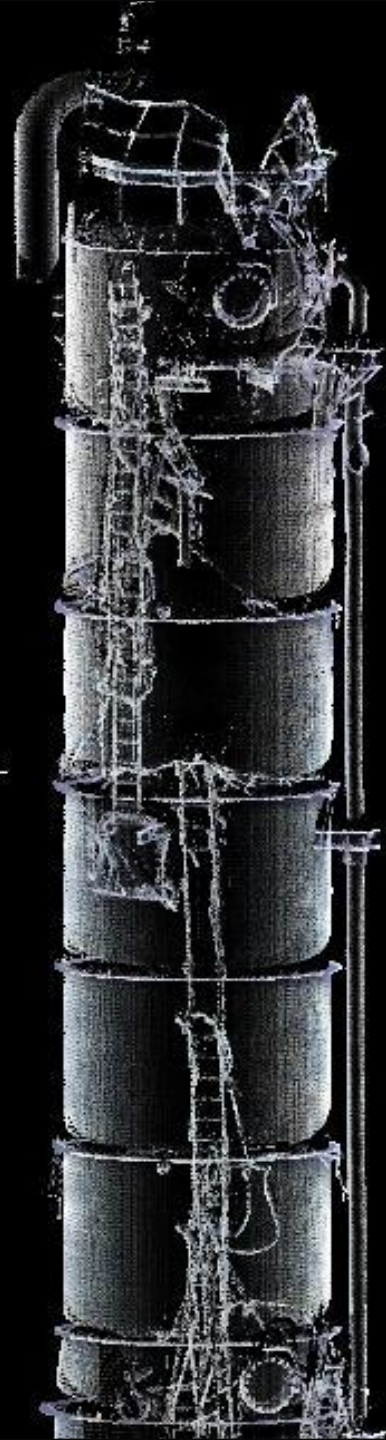






Upper Section  
Looking NE

+

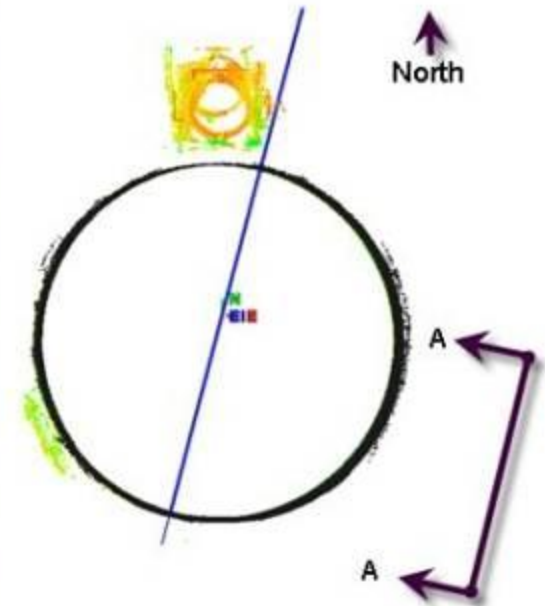


1"x1" grid

Section A-A: View of Section 2 looking  
West-NW

North

Plan View

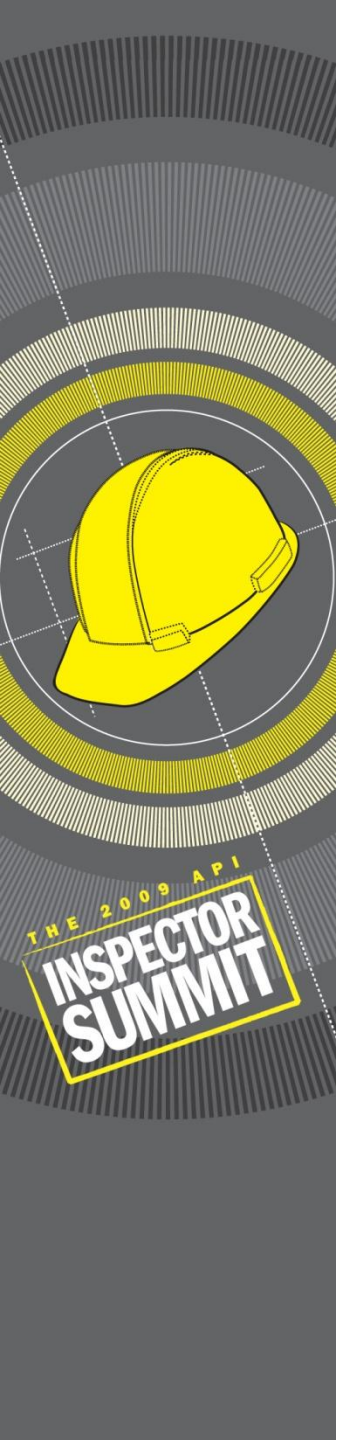


# Realize

You are not in control.

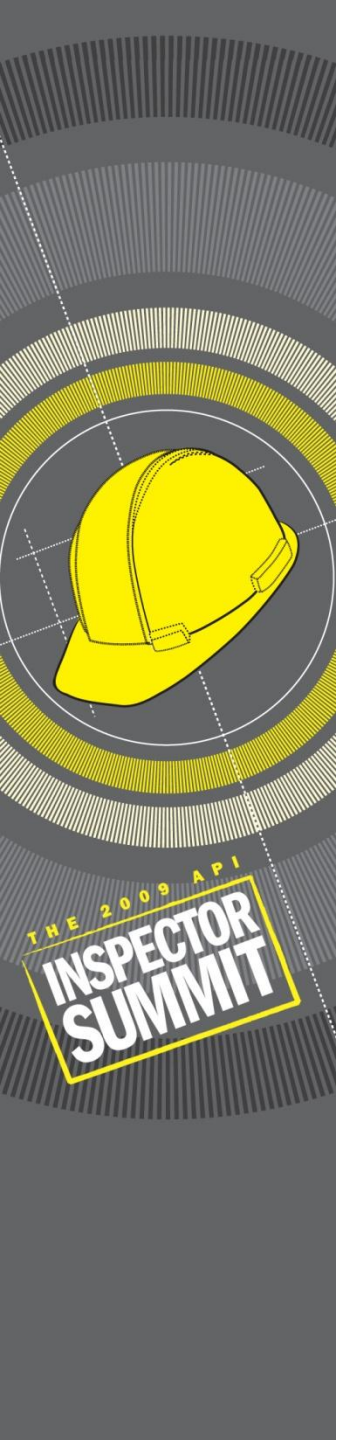
You have no hope of being in control.

Once you give up all hope, you feel much better.



# The Best You Can Hope For:

We may be lost, but we're making good time.



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