QUARTERLY REPORT

Project WP#339: Structural Significance of Mechanical Damage

For Period Ending: February 28, 2009

Contract No: DTPH56-08-T-000011

Prepared For: United States Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety

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PRCI LEADING PIPELINE RESEARCH

Milestone and Deliverable Accomplishments this Reporting Period

Task No.	Task	Scheduled Completion Date	Completed Date	Milestone
2	Purchase & Characterize Pipe Material	11/30/2008	Ongoing	
3	Literature Review	11/30/2008	Ongoing	
4	Testing of Dents on Welds and Corrosion Features	11/30/2009	Ongoing	MS
5	Testing of Dents with Gouges	5/31/2010	Ongoing	MS
6	Demonstration of Mech. Damage Model Performance	11/30/2009	Not Yet Started	
7	Industry Workshop	5/31/2010	Not Yet Started	
8	Project Management and Reporting	5/31/2010	Ongoing	MS

Technical Status

Technical activities undertaken through the third quarter focused on the following tasks:

Task 2: Purchase & Characterize Pipe Material
Task 3: Literature Review
Task 4: Testing of Dents on Welds and Corrosion Features
Task 5: Testing of Dents with Gouges

A summary of the technical status and results or conclusions to date are presented below for each of these tasks.

The technical group for this program has maintained close communication to ensure program coordination, including coordination with related PRCI projects. Issues of concern in the program will be forwarded to PRCI and DOT for their consideration.

Task 2: Purchase & Characterize Pipe Material

Technical Status

The entire program comprises 3 different pipe steels (IPSCO pipes manufactured during 2005/2006) called:

- Pipe 1
- Pipe 2
- Pipe 3

GDF SUEZ has received three pipes of 11.8 meters length of Pipe 1 and two pipes of 11.8 meters length of Pipe 2. These pipe steels are current steels, one specified API X52 grade and the second API X70 grade. The diameter of all pipes is 24'' and the thicknesses are 7.9mm for the X52 grade (Pipe 1) and 9.0mm for the X70 grade (Pipe 2). The pipes are manufactured by IPSCO with ERW process.

In the previous quarterly reports, GDF SUEZ presented material characterization results for Pipe1:

- Tensile properties in longitudinal and transverse directions;
- Charpy V impact values in different directions at room temperature;
- Toughness J Curve;
- Size of slip bands (Extra-work)

In the 3rd Quarterly period, the material characterization had been implemented for Pipe 2 and is presented in this report:

- Tensile properties in longitudinal and transverse directions;
- Charpy V impact values in different directions at room temperature;
- Toughness J Curve;

Progress was made regarding the identification of pipe materials to represent older/vintage pipe for completing the testing program. A source has been identified for the manufacture of pipe with material properties replicating the observed lower toughness of 1950's or 1960' era linepipe, and cost/schedule data has been collected. The procurement schedule will meet the requirements of the project, as the materials manufactured would be available. However, the cost is substantially more than the funding allotted in the project budget for this task. One of the primary costs drivers is the need to purchase the entire heat of steel from the manufacturer. The additional steel would likely prove to be a substantial benefit to other research projects investigating various forms of degradation or damage to older pipeline steel.

The Project Technical Team has discussed the procurement of the vintage pipe with PHMSA. During the project kick-off meeting, PHMSA indicated a strong preference for the use of a manufactured pipe for the project testing rather than a vintage pipe removed from service (from a PRCI member company), as a manufactured pipe with vintage properties would not have been subjected to variations and unknown conditions during its operating history. The additional costs for the manufactured piping option have been raised with PHMSA, and the Project Technical Team is preparing a summary plan outlining the steel procurement justification and cost analysis.

Task 3: Literature Review

Technical Status

There is no substantive additional information pertaining to the literature review task to report. Any new information on pre-strain effect on toughness and on realistic defects from field feedback will be captured as it becomes available from other sources.

Task 4: Testing of Dents on Welds and Corrosion Features

Technical Status

The testing procedure, measurements and measurement systems/equipment, reporting and schedule details have been clarified and documented to allow testing to begin. The testing process will make use of a new higher capacity water pump purchased for this project and will increase the rate of testing in the program.

Results and Conclusions
Testing will commence in the next quarter with the first six test specimens being instrumented to capture the dent strain responses. An analysis of costs to more completely instrument the test specimens and add 100% radiographic inspection of welds is being prepared and will be forwarded to PRCI and DOT for consideration.

Task 5: Testing of Dents with Gouges

Technical Status
GDF SUEZ has in charge the creation, characterization, burst test and fatigue test of realistic combined defects "gouge in dent" following the program described in the next table:

The defects are identified by three characters **x.y.z.** which are numbers:

- **x.**y.z.: **x** identifies the **Pipe x** material which can be in this program, 1, 2, or 3;
- x.**y.**z.: **y** defines the type of combined defect characterized by its geometry notably in terms of dent depth and length and gouge depth and length. In this program, the value of y can be in the range of 1 to 3, this program considering a maximum of three different kinds of defects per pipe material.
- x.y.**z.**: **z** is the number of defect in the defined type of defect. There are three similar defects per type of defect. The number 1 is for a detailed geometrical, mechanical and metallurgical in-depth defect characterization after its creation. Number 2 is a similar defect for the burst test to evaluate the defect behavior of under monotonic pressure load and number 3 is a similar defect for the fatigue test to evaluate the defect behavior under cyclic variation of the internal pressure.

In the previous quarterly reports, the following results were presented:

- Creation conditions and results of defects 1.1.1, 1.1.2, 1.1.3, 1.2.1, 1.2.2., 2.1.1 and 2.1.2
- Burst test condition and results of defect 1.1.2, 1.2.2 and 2.1.2
- Fatigue test condition and result of defect 1.1.3,

This report presents the creation conditions and results of defects 1.2.3, 2.1.3, 1.1.1b and 1.2.1b. The strain during the creation of defects 1.2.3 and 2.1.3 have been recorded on internal pipe wall under the impact location of the tooth. The defects 1.1.1b and 1.2.1b are the defects 1.1.1 and 1.2.1, as the earlier created defect samples were subjected to pressure variations by error. In addition, this report also gives results on metallurgical investigation on defect 1.2.2 after burst failure.

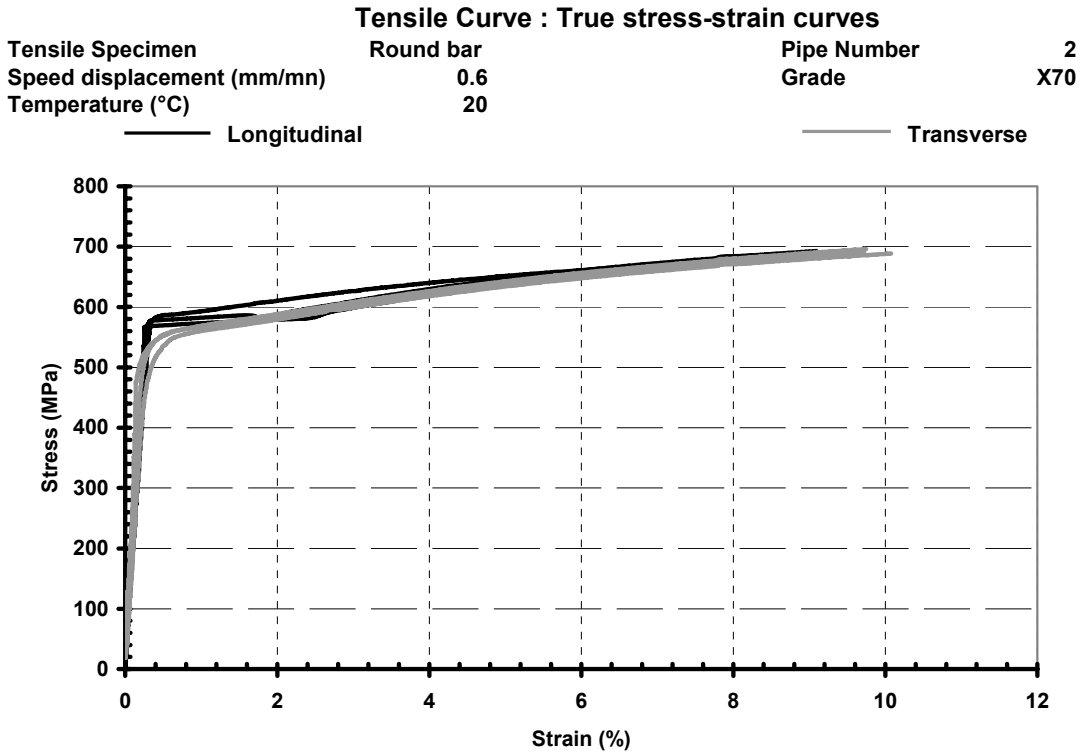
The table below summarizes the progress of the study on defects "Gouge in dent" for the entire program. The defects that were created during the last quarter and presented in this report appear with yellow background:

PR 305, pipe 1 & pipe 2	MD 4-1					DOT	
Pipe number	**Pipe 1** (current steel X52)			**Pipe 2** (current steel)		**Pipe 4** (older steel)	
Defect type agreed with Project team	Type 1	Type 2	Type 3	Type 1 or 2	Type 2 or 3	Type 1 or 2	Type 2 or 3
Defect 1: Detailed characterization	Defect 1.1.1b	Defect 1.2.1b	*Defect 1.3.1*	Defect 2.1.1	*Defect 2.2.1*	*Defect 4.1.1*	*Defect 4.2.1*
Defect 2: Burst test	Defect 1.1.2	Defect 1.2.2.	*Defect 1.3.2*	Defect 2.1.2.	*Defect 2.2.2*	*Defect 4.1.2*	*Defect 4.2.2*
Defect 3: Delayed failure	Defect 1.1.3	*Defect 1.2.3.*	*Defect 1.3.3*	*Defect 2.1.3*	*Defect 2.2.3*	*Defect 4.1.3*	*Defect 4.2.3*

Results and Conclusions

Material characterization of Pipe 2:

- ***Tensile properties***



	Longitudinal			Transverse		
	Test 1	**Test 2**	**Test 3**	**Test 1**	**Test 2**	**Test 3**
YS (MPa)	584	576	567	535	538	547
UTS (MPa)	626	633	624	623	632	628
Elongation (%)	25	27	27	26	26	25
K*	829	921	776	904	918	914
n*	0.08	0.12	0.12	0.12	0.12	0.12

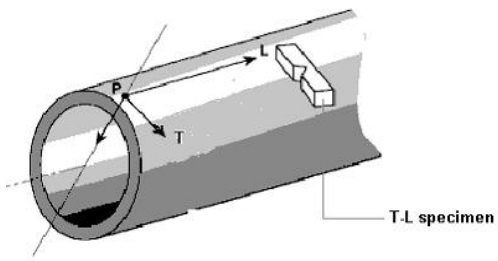
*Isotropic hardening law coefficients:

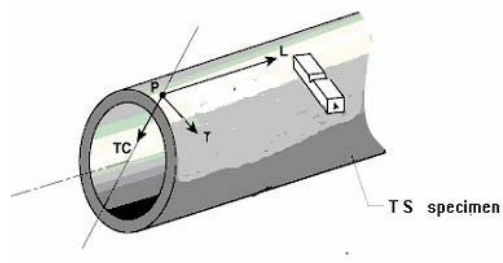
$$\sigma = K\varepsilon_p^{\,n}$$

The mechanical behavior is close to an isotropic one, with slightly larger yield strength in longitudinal direction.

- ***Charpy Impact values***

The Charpy impact values were determined at room temperature in two directions, TL and TS





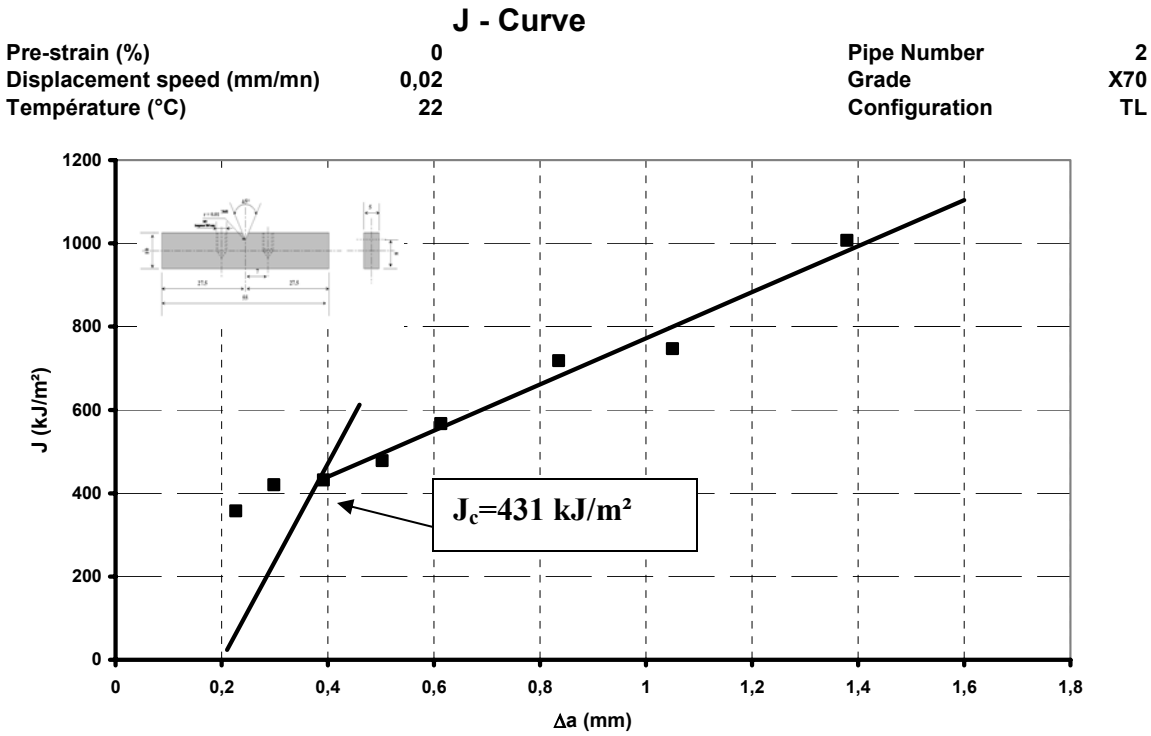
The Charpy specimens are sub-size, with different geometries for TL and TS. Three tests were repeated per direction. The table below gathers the results.

	TL			TS		
	Test 1	**Test 2**	**Test 3**	**Test 1**	**Test 2**	**Test 3**
Charpy value (J)	187	203	212	158	158	154
Mean Value (J)	**201**			**157**		

For each test, the specimens did not break apart and the fracture is 100% ductile.

- ***Toughness J-Curve***

J-Curve has been determined by multiple specimens method (ISO 12135) with SENB specimens in TL direction at room temperature



The fracture crack initiation and propagation spend high energies. The behavior is fully ductile.

Creation of defects 1.2.1b and 1.2.3

These defects were created in the same conditions as previously defects 1.2.1 and 1.2.2.

Tooth type	Impact angle α (°)	Drop Height (mm)	Additional Mass (Kg)	Internal Pressure (bar)
Esco	76	270	800	85 Load factor: 0.73

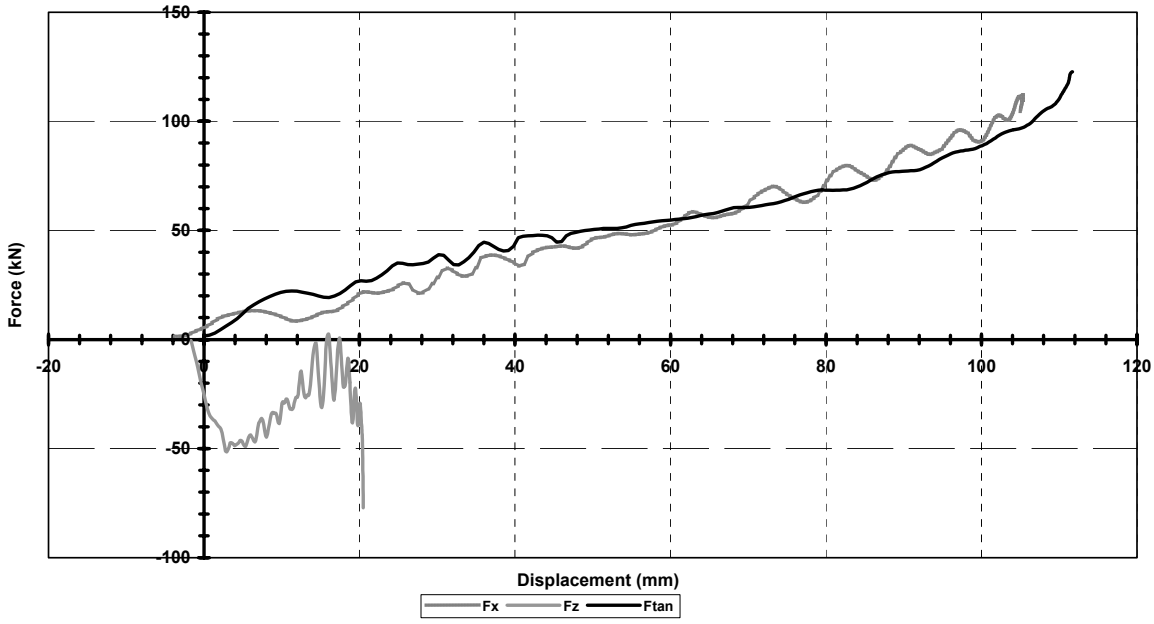
The forces versus displacements are plotted below and the energy spent for the defect creation appears in the upper left corner:

DEFECT 1.2.1.b

Force versus displacement during defect creation

Actual load factor : 0.73
Internal pressure (bar) : 85
Total absorbed Energy (J) : 5816
Tooth type : ESCO

Diameter (mm) : 609.6
Thickness (mm) : 7.9
Grade : X52
Pipe number : 1

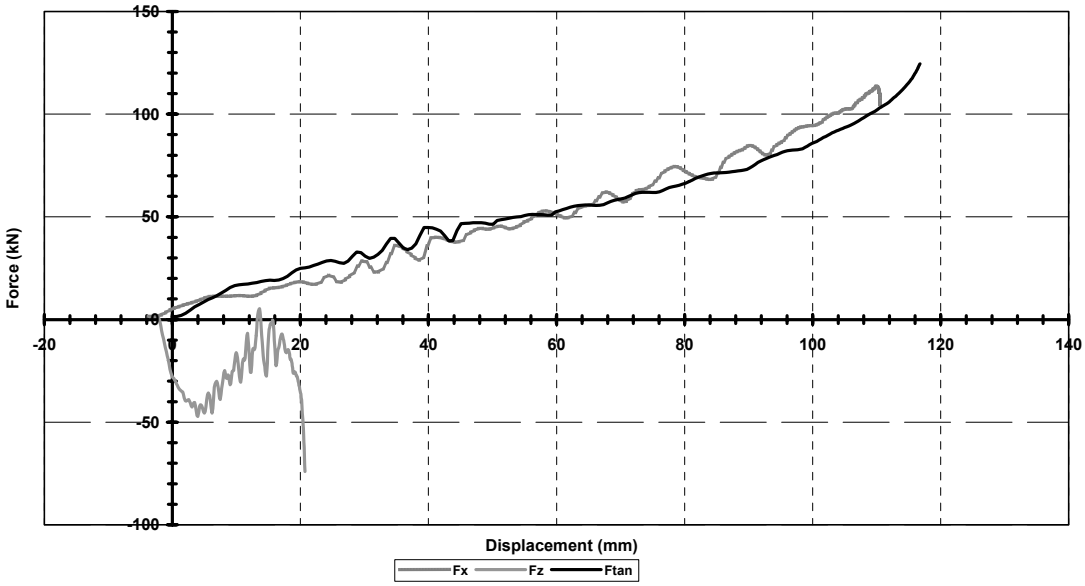


DEFECT 1.2.3

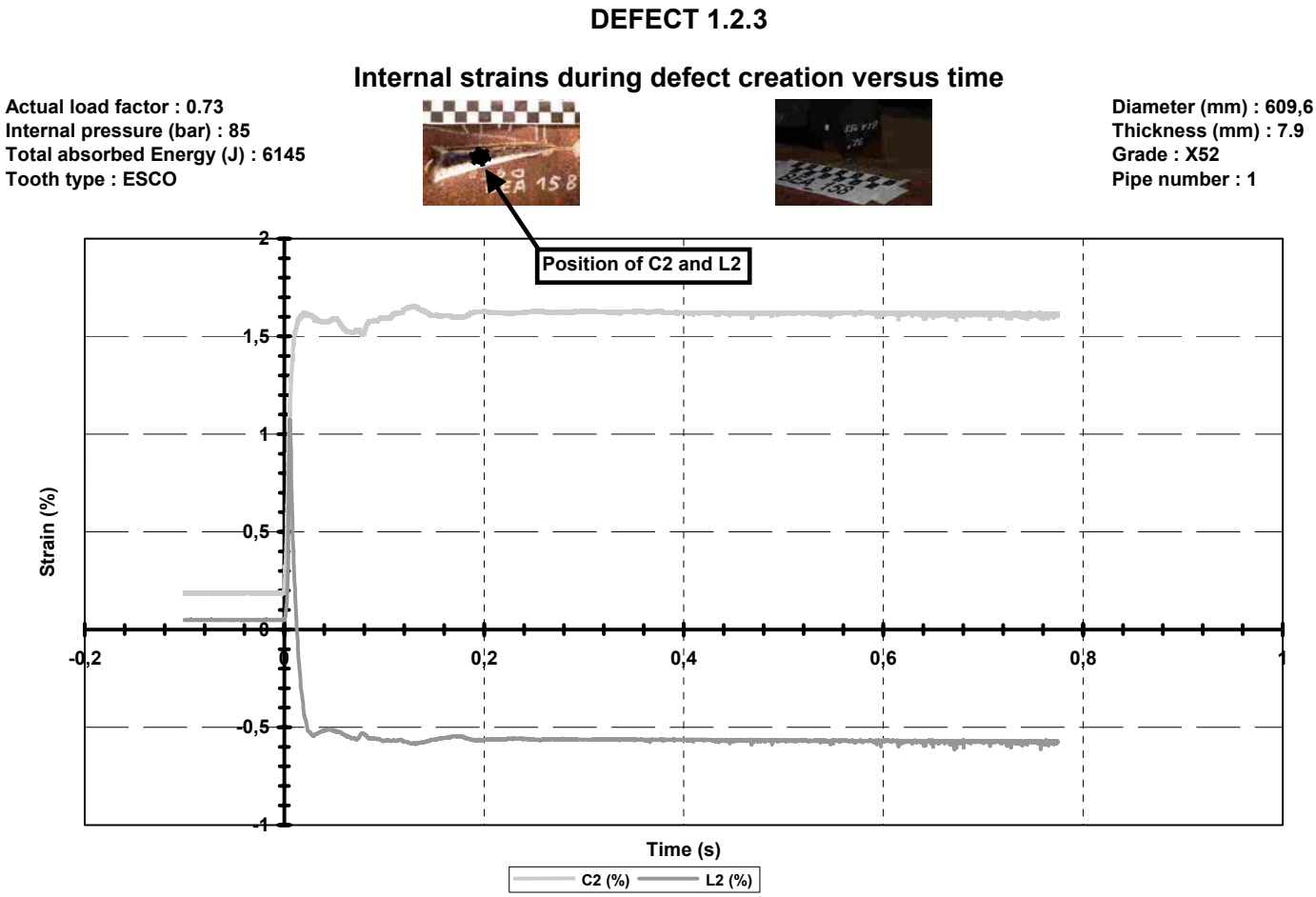
Force versus displacement during defect creation

Actual load factor : 0.73
Internal pressure (bar) : 85
Total absorbed Energy (J) : 6145
Tooth type : ESCO

Diameter (mm) : 609.6
Thickness (mm) : 7.9
Grade : X52
Pipe number : 1



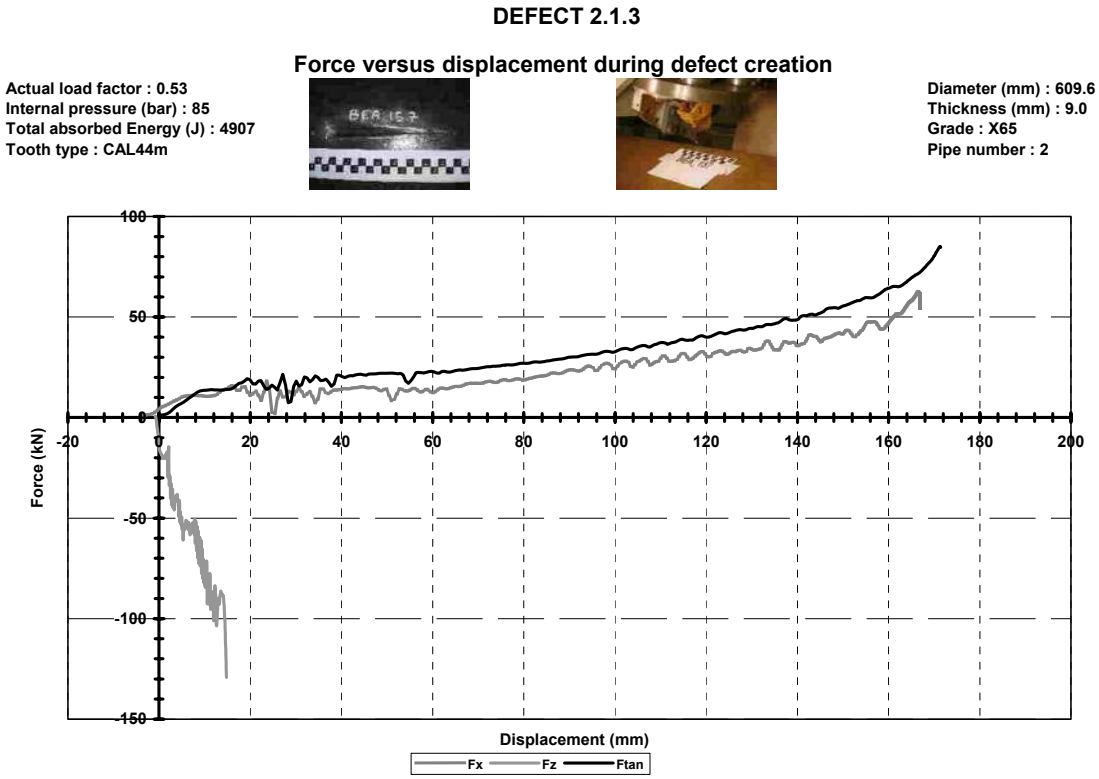
In addition, strains from internal gauges were recorded during the defect creation. C2 and L2 are respectively circumferential and longitudinal strain gauges placed as indicated in the figure below.



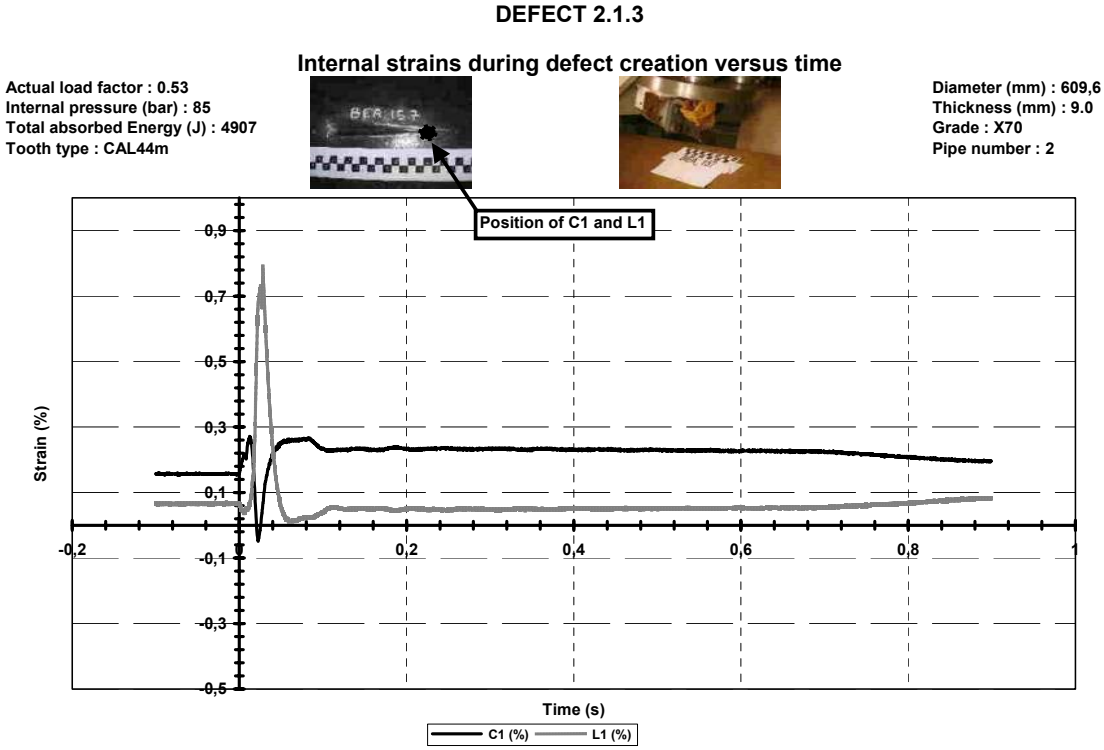
Creation of defect 2.1.3

Tooth type	Impact angle α (°)	Drop Height (mm)	Additional Mass (Kg)	Internal Pressure (bar)
Cal44m	81	170	800	85 Load factor : 0.53

Forces versus displacement during the defect creation are plotted below, and energy spent for the defect creation appears in the upper left corner of the figure.



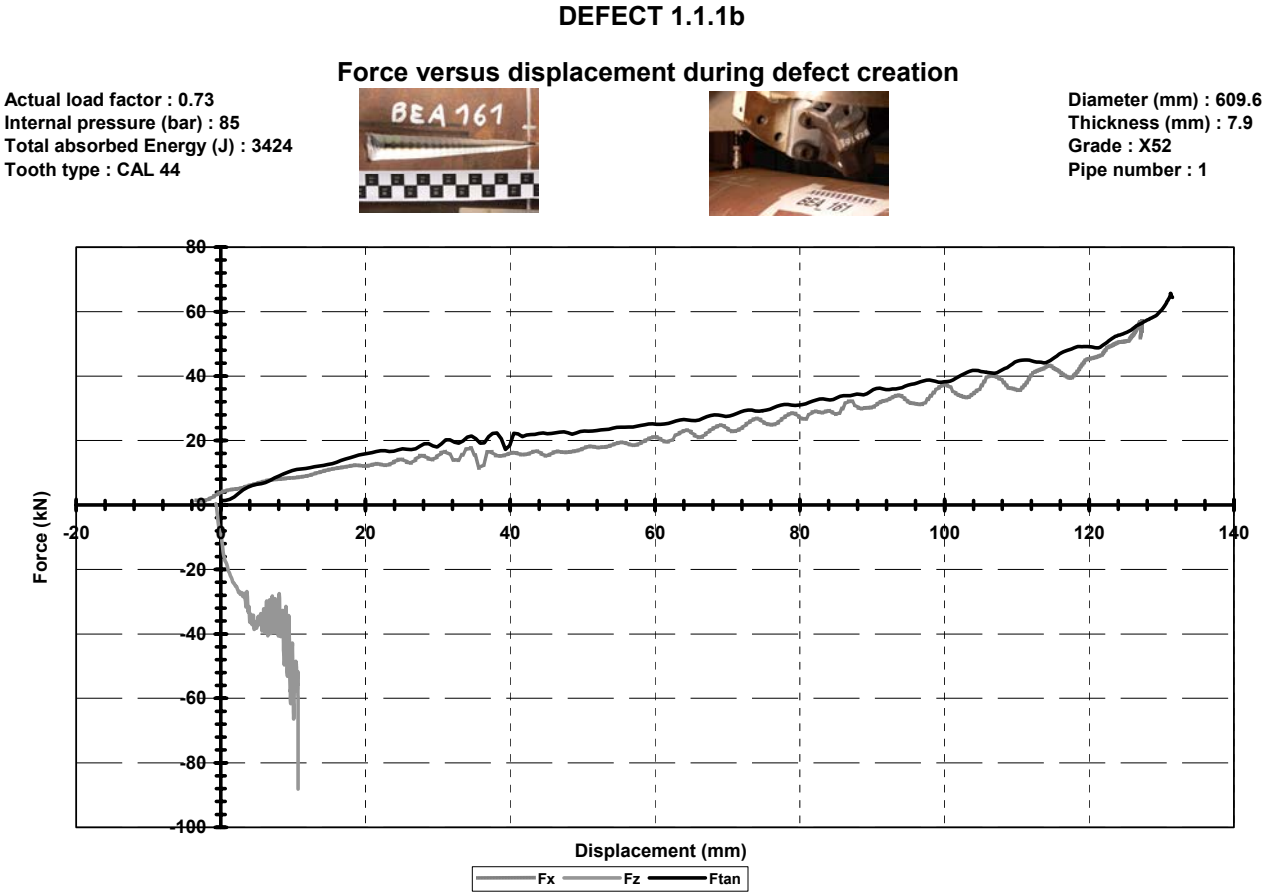
Internal C1 – circumferential – and L1 – longitudinal – strains during defect creation are plotted below.



Creation of defect 1.1.1b

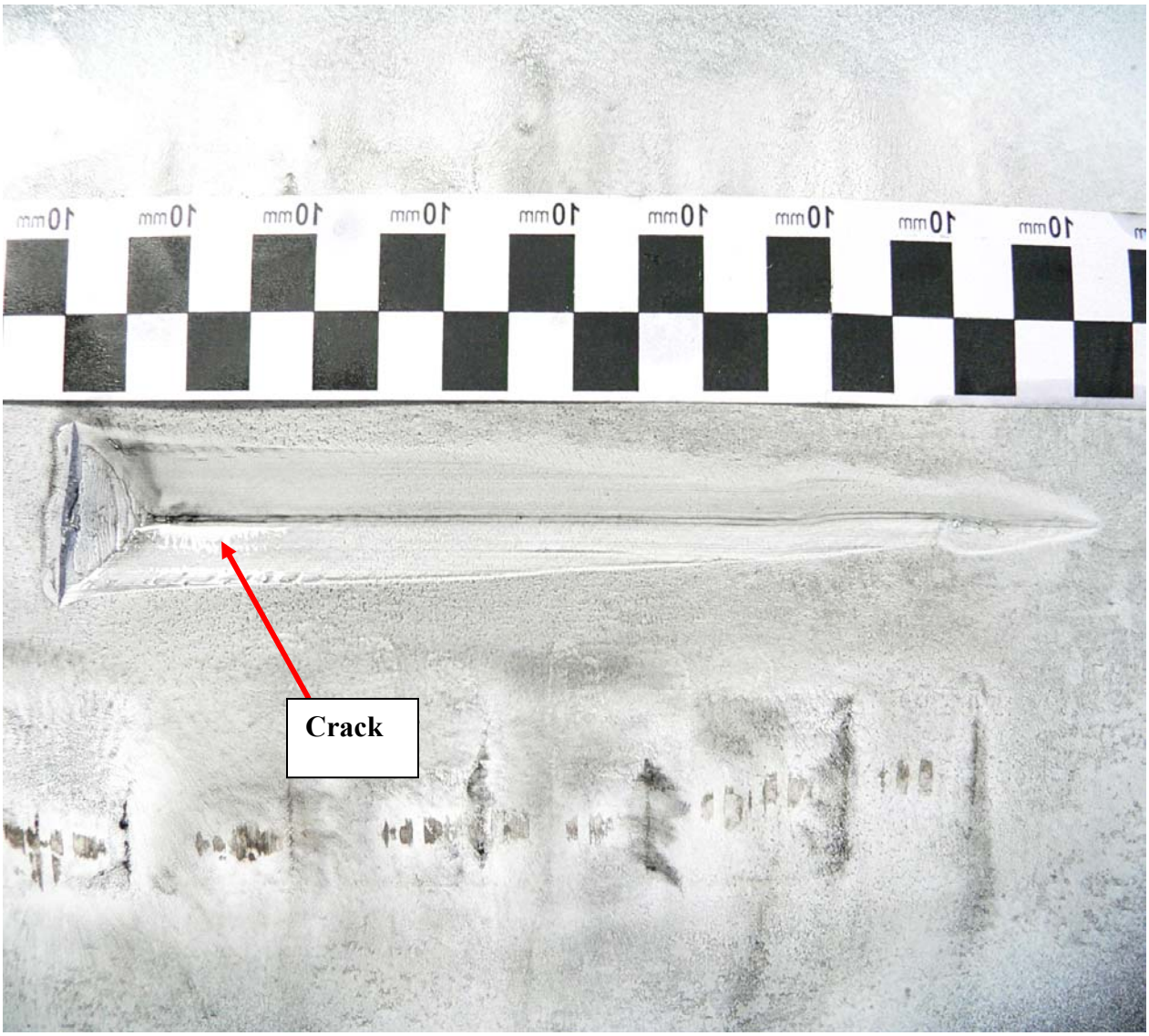
Tooth type	Impact angle α (°)	Drop Height (mm)	Additional Mass (Kg)	Internal Pressure (bar)
Cal44	81	170	0	85 Load factor : 0.73

Forces versus displacement during defect creation are plotted below and energy spent for the defect creation appears in the upper left corner of the figure.



Characterization of defects 1.1.1b, 1.2.1b, 1.2.3 and 2.1.3

For each defect, magnetic particle inspection (MPI) was performed and 2D longitudinal and transverse profiles were deduced from 3D laser mapping. For each defect, the magnetic particle inspection revealed the presence of cracks and micro-cracks in the gouge, e.g. as shown in the figure below (defect 2.1.3)



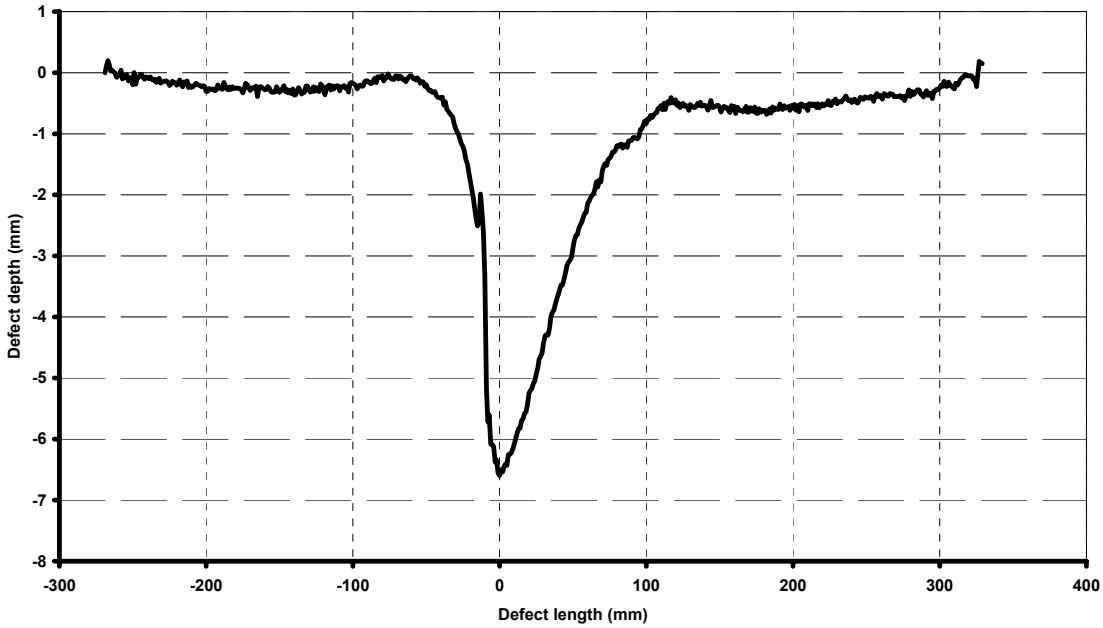
The following figures show the Circumferential and Longitudinal profiles of each defect:

DEFECT 1.1.1b

2D longitudinal profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : CAL 44

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

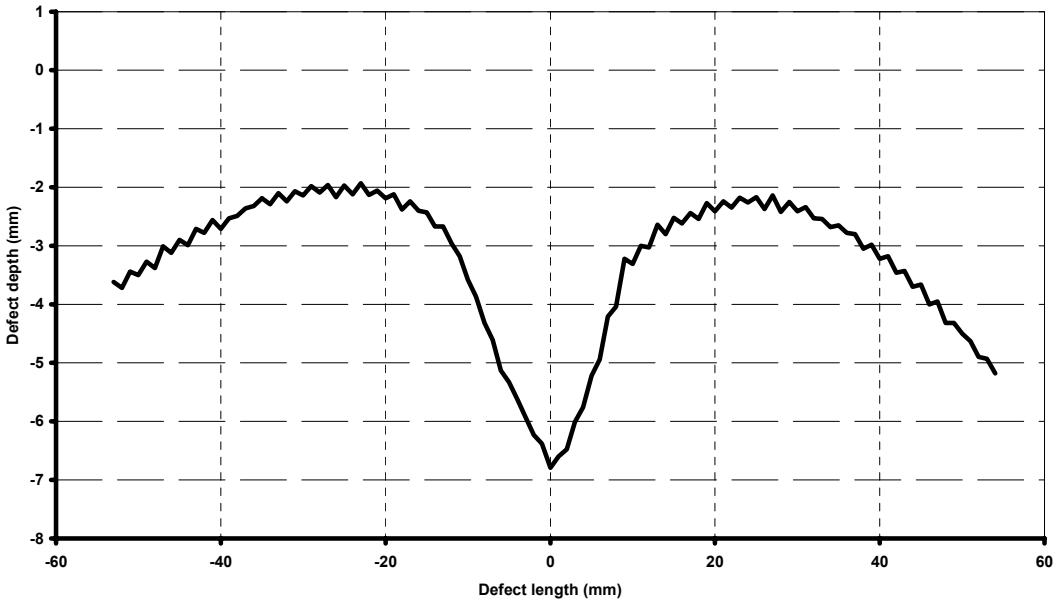


DEFECT 1.1.1b

2D circumferential profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : CAL 44

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

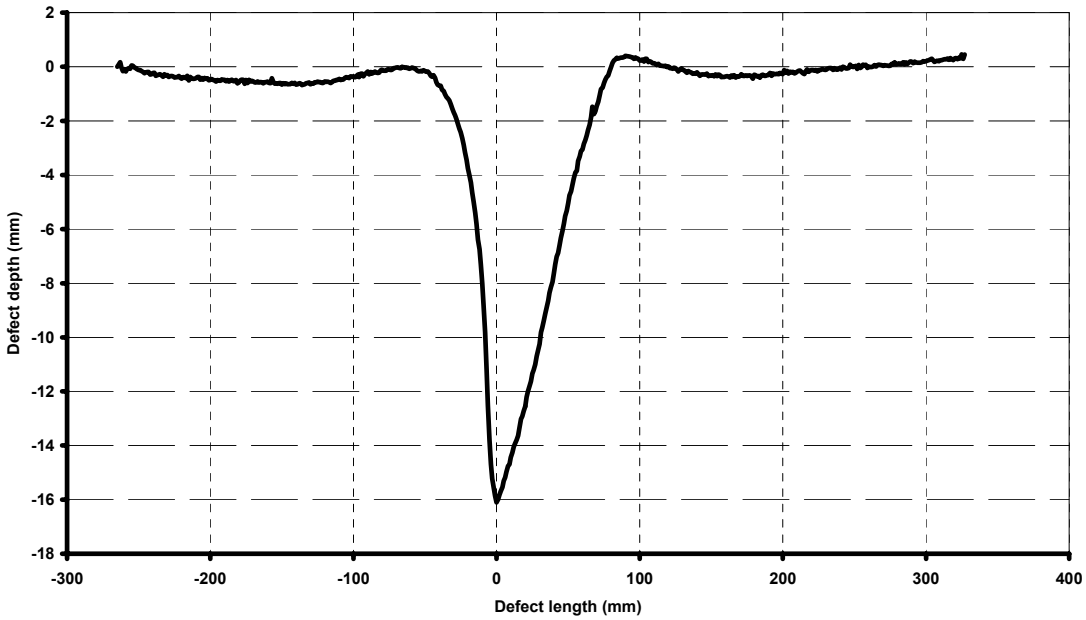


DEFECT 1.2.1b

2D longitudinal profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : ESCO

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

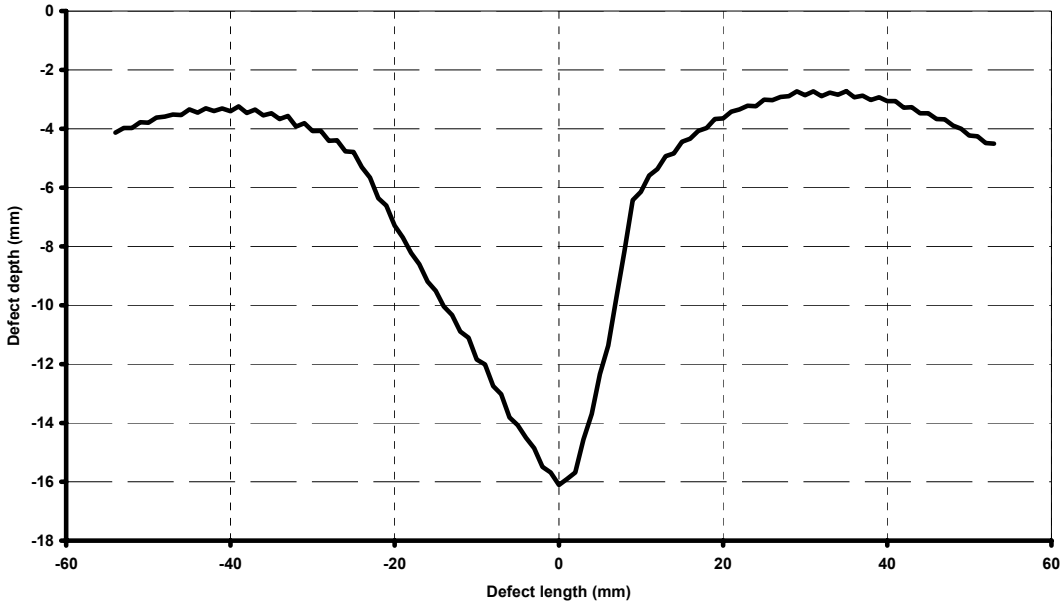


DEFECT 1.2.1b

2D circumferential profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : ESCO

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

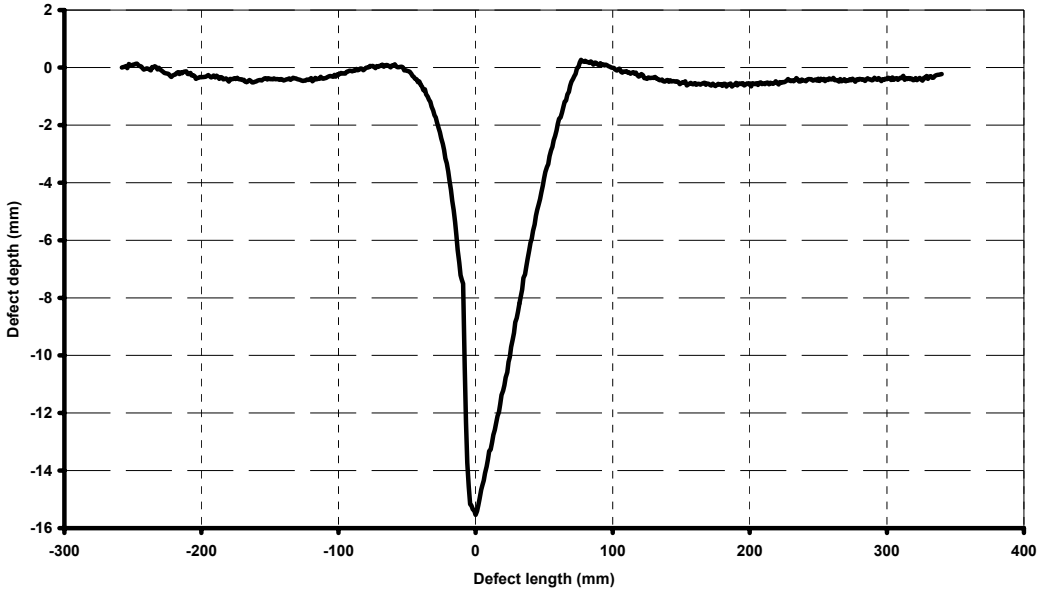


DEFECT 1.2.3

2D longitudinal profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : ESCO

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

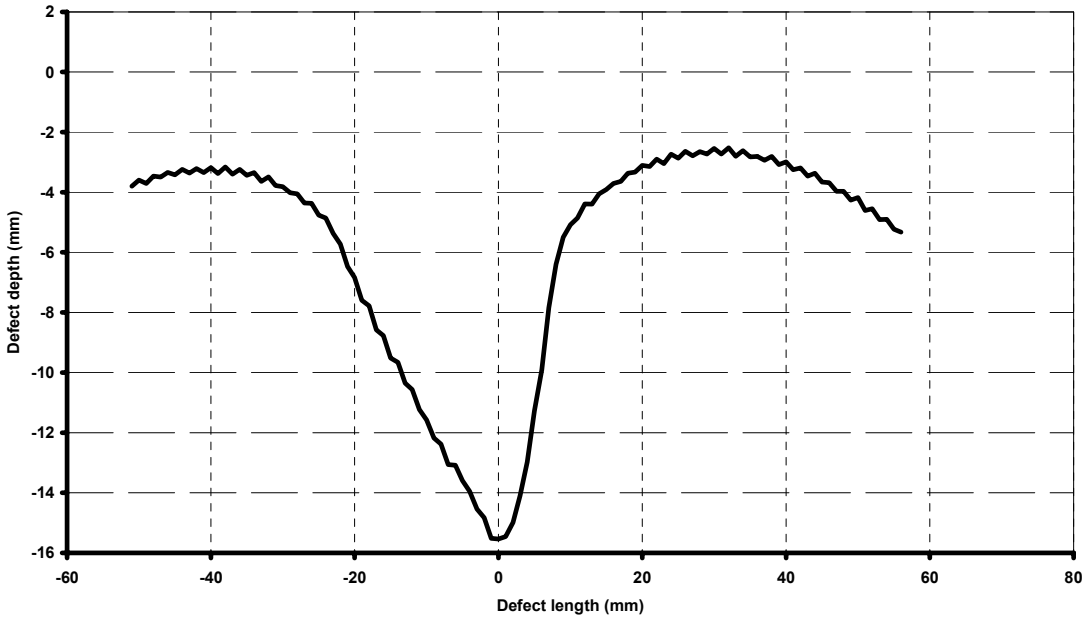


DEFECT 1.2.3

2D circumferential profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.73
Internal pressure during defect creation (bar) : 85
Tooth Type : ESCO

Pipe N° : 1
Diameter (mm) : 609,6
Thickness (mm) : 7.9
Grade : X52

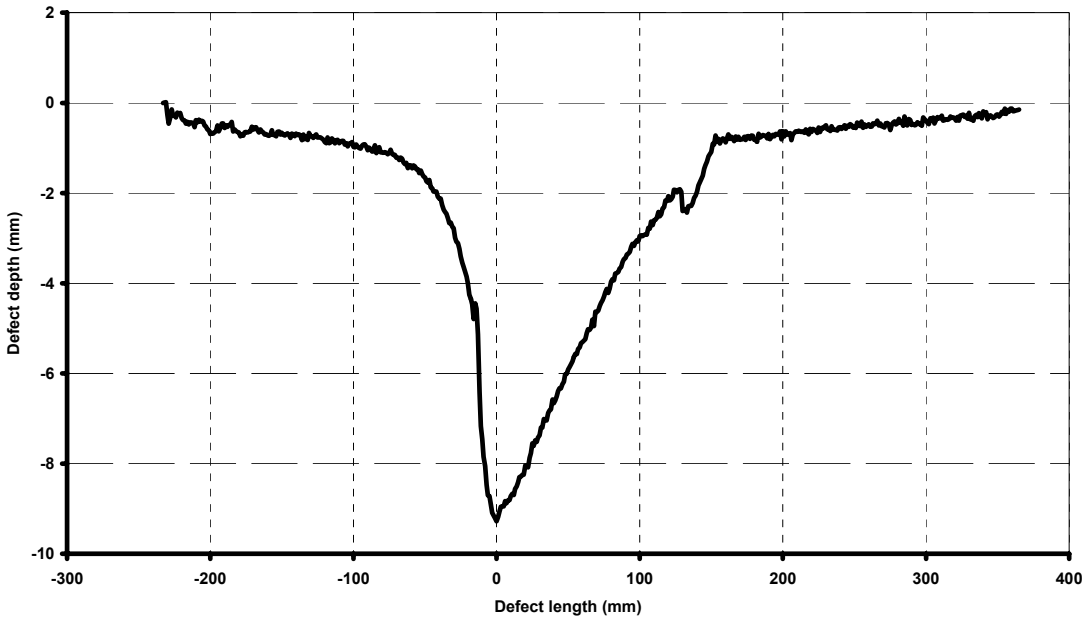


DEFECT 2.1.3

2D longitudinal profile passing by the deepest point of defect (pressure = 0 bar)

Actual load factor : 0.53
Internal pressure during defect creation (bar) : 85
Tooth Type : CAL44m

Pipe N° : 2
Diameter (mm) : 609.6
Thickness (mm) : 9.0
Grade : X65

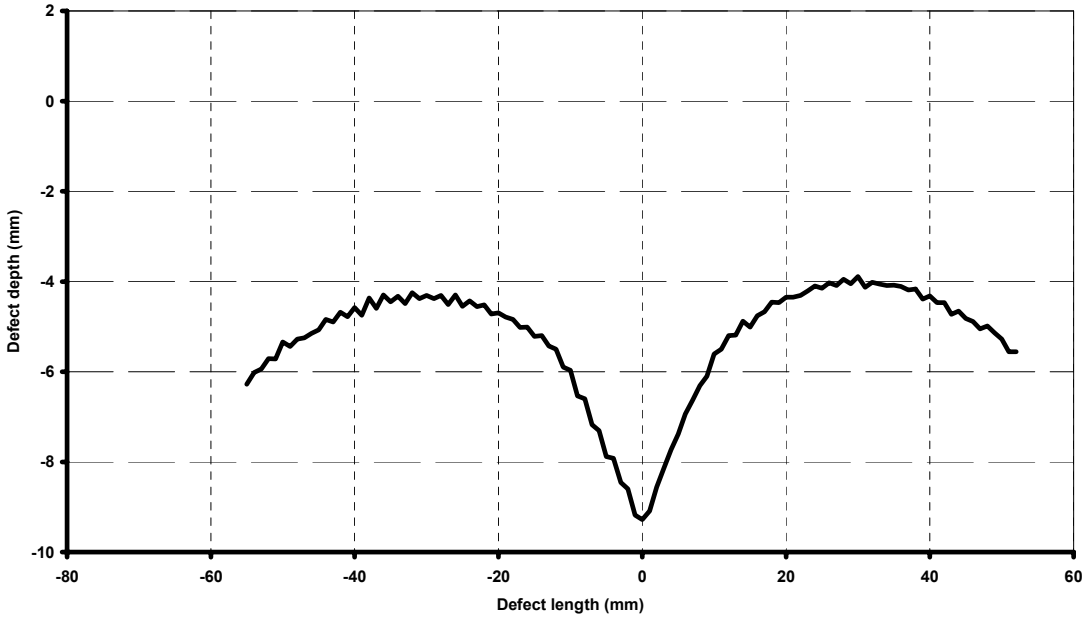


DEFECT 2.1.3

2D circumferential profile passing by the deepest point of defect (pressure = 0 bar)

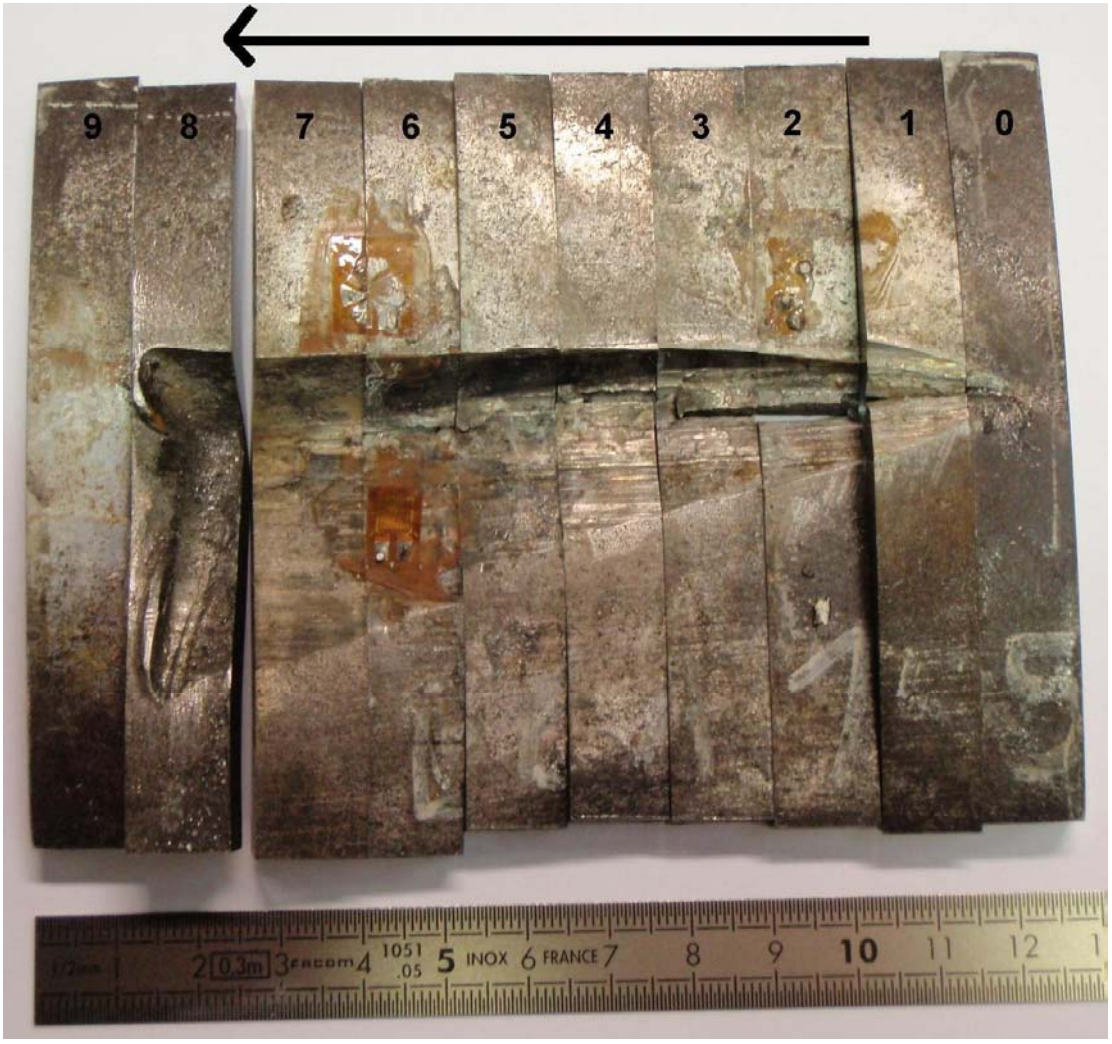
Actual load factor : 0.53
Internal pressure during defect creation (bar) : 85
Tooth Type : CAL44m

Pipe N° : 2
Diameter (mm) : 609.6
Thickness (mm) : 9.0
Grade : X65

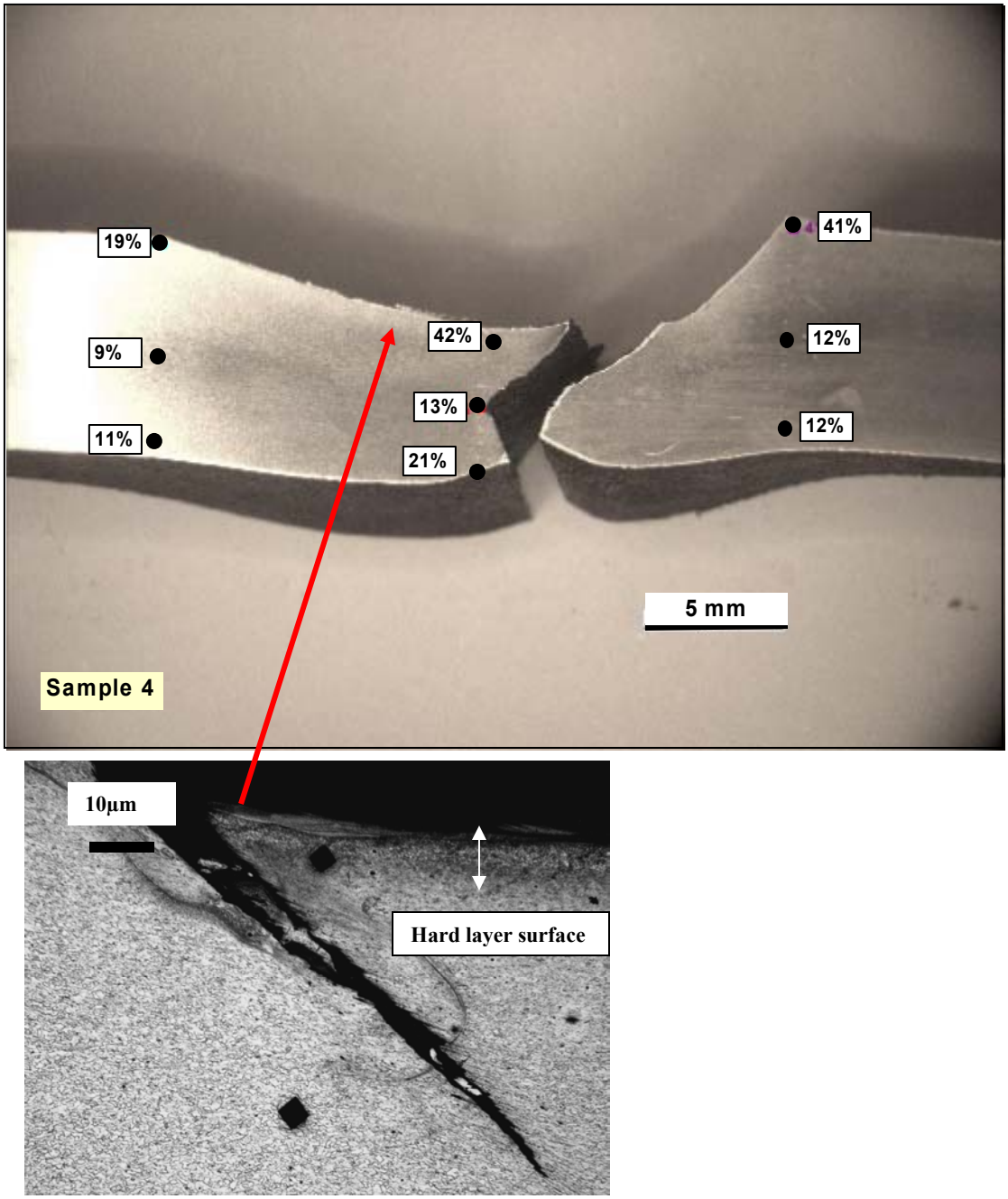


Metallurgical investigation of defect 1.2.2 after burst failure

Defect 1.2.2 was cut in 10 samples for metallographic investigation consisting of sizing the depth of cracks and micro-cracks and comparing them with the thickness of the hardened layer at the external surface of the gouge and to estimating the local strains by micro-hardness calibration.

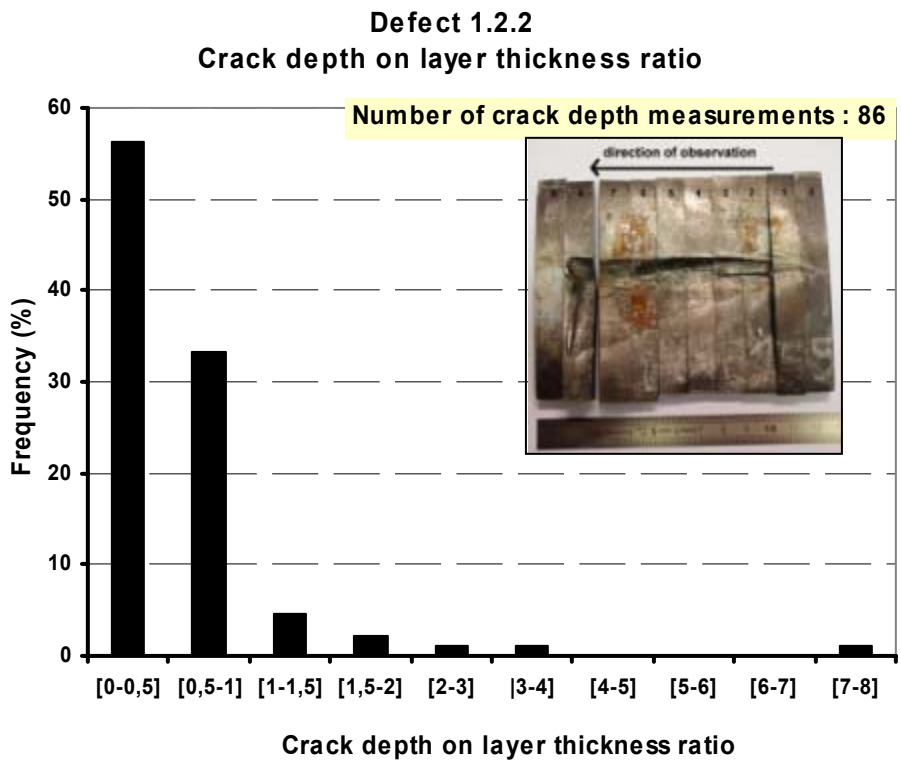


Cut of defect 1.2.2 in 10 samples



Evaluation of local strains in sample 4 and microscopic view of crack and hardened layer microstructure close to external surface of gouge.

The ratio of crack depth over hardened layer thickness was determined for all cracks found in all samples and summarized in the histogram below.



More than 85% of cracks are shorter than the hardened layer thickness. An interpretation is that they were probably initiated during defect creation or re-rounding just after the mechanical impact and then have remained stable during the burst test. Only a few significantly deeper ones eventually evolved / coalesced into the crack that grew to become critical.

Main Conclusions:

Material Characterization of pipe 2

The pipe 2 material specified as X70 grade exhibits characteristics that are consistent with a high strength steel close to X80 with a high ductility and a very good toughness characterized by the J-Curve.

Creation of defects 1.1.1b, 1.2.1b, 1.2.3 and 2.1.3:

- All defects were created with forces and displacements recorded during the creation. In addition, for defects 1.2.3 and 2.1.3, strain gauges placed on the internal pipe wall under the impact location provided local strain information during defect creation, as requested by associated projects in terms of extra work.
- All defects were characterized by 3D laser mapping and controlled by magnetic particle inspection. All gouges ***created in these conditions*** are associated with external micro-cracks and cracks.

Metallurgical investigation of defect 1.2.2 after burst failure:

- On different cuts, micro-hardness measurements reveal by calibration indications of local strains that are in excess of 40% close to the gouge surface.
- A hardened layer micro-structure is observed at the gouge surface with a depth in the range of 100 µm to 200 µm.
- More than 85% of cracks observed on the 10 cut sample surfaces have a depth shorter than the thickness of the hardened layer. Only a limited number of cracks may have evolved to failure during the burst test.

Business Status

The project remains well coordinated with the pipeline industry through the PRCI partnership on the project. Please refer to Attachment 1 for a summary of details about the resource status of this Agreement. This attachment includes a quarterly accounting (broken up by Project milestones) of budgeted, current and cumulative expenditures, including cost share amounts. The attachment also explains any major deviations and discusses the adjustment actions proposed.

Schedule & Payable Milestones

Task 2 is slightly behind schedule due to identifying pipe and collecting cost/schedule data for the vintage pipe. Task 3 is behind due to capturing data as it becomes available from sources. Neither task will delay the overall schedule of the project.

Task No.	Task	Status	Scheduled Completion Date	Payable Milestone (Item No)
1	Project Kick Off Meeting and Subcontracting	100% Complete	8/31/2008	
2	Purchase & Characterize Pipe Material	60% Complete	11/30/2008	
3	Literature Review – effect of pre-strain and dent-gouge defect from field feed-back	70% Complete	11/30/2008	
4	Testing of Dents on Welds and Corrosion Features	50% Complete	11/30/2009	12
5	Testing of Dents with Gouges	38% Complete	5/31/2010	13
6	Demonstration of Mech. Damage Model Performance	0% Complete	5/31/2010	
7	Industry Workshop	0% Complete	5/31/2010	
8	Project Management and Reporting	On-Going	5/31/2010	15

Issues, Problems or Challenges

- To improve the similarity between the created defects of the same type, the aggression

tooth has to be examined after the impact test and reshaped to get as close as possible to the same geometry as initially before launching the following test to create a similar defect.

- For defects 1.2.3 and 2.1.3, strain gauges were placed before defect creation on the internal walls of the vessels in the areas where the defects were created. These strain gauges recorded the strain evolution on the internal wall sides of the two defects during their creation. Some of the initially installed gauges failed during defect creation, and their performance will be monitored during subsequent fatigue and burst tests. This extra work with respect to the contract involved a delay of two weeks.
- Defects called x.x.1 are introduced on the same vessel for a given material. This process avoids to waste material using the same vessel for different x.y.1 defects. The consequence is that the residual stress determination and the metallurgical characterization of these already created defects will be performed at the end of the defect creation process for a given material (Pipe 1, Pipe 2, or Pipe 3).

Plans for Future Activity

Task 2: Purchase & Characterize Pipe Material

The Project Team is preparing a summary plan outlining the steel procurement justification and cost analysis. Results on pre-strain effect on toughness for Pipe 1 and Pipe 2 materials will be compiled.

Task 3: Literature Review

Any new information on pre-strain effect on toughness and on realistic defects from field feedback will be captured as it becomes available from other sources, like conferences, workshops and results of other PRCI projects.

Task 4: Testing of Dents on Welds and Corrosion Features

Full scale testing of the plain dents in the test matrix will be completed with a start planned for the dents on corrosion features.

Task 5: Testing of Dents with Gouges

- Fatigue tests for defects 1.2.3 and 2.1.3 will be launched as soon as their instrumentation is finished.
- Creation of defects 1.3.1 and 2.2.1 with internal strain gauges will be launched. During the February 2009 PRCI Research Exchange Meeting (Atlanta, GA, February 3-5, 2009), the MD4-1 project team decided that the type of these defects should be a deep dent and a shallow gouge, to better cover the range of defects identified through a separate PRCI research project (Project MD 2-1, ***Inventory of Types of Mechanical Damage Experienced by Gas and Oil Pipelines***).
- Fractographic investigation of failed defects will be completed by SEM on the fracture surfaces.

Attachment 1: Business Status Section

DOT Portion				
Item No.	Task No.	Budgeted Amount	Current Amount	Cumulative Amount
1	1	$ 9,335	$ 9,335	$ 9,335
2	2	$ 19,567	$ 19,567	$ 19,567
3	3	$ 8,111	$ 8,111	$ 8,111
4	4	$ 32,606	$ 32,606	$ 32,606
5	5	$ -	$ -	$ -
N/R	6	$ -	$ -	$ -
N/R	7	$ -	$ -	$ -
6	8	$ 7,747	$ 7,747	$ 7,747
First Qtr		$ 77,366	$ 77,366	$ 77,366
N/R	1	$ -	$ -	$ 9,335
7	2	$ 15,107	$ -	$ 19,567
8	3	$ 3,438	$ -	$ 8,111
9	4	$ 31,325	$ 31,325	$ 63,931
10	5	$ 34,559	$ 34,559	$ 34,559
N/R	6	$ -	$ -	$ -
N/R	7	$ -	$ -	$ -
11	8	$ 7,747	$ 7,747	$ 15,494
Second Qtr		$ 92,177	$ 73,632	$ 150,997
N/R	1	$ -	$ -	$ 9,335
N/R	2	$ -	$ -	$ 19,567
N/R	3	$ -	$ -	$ 8,111
12	4	$ 31,144	$ 31,144	$ 95,075
13	5	$ 33,270	$ 33,270	$ 67,829
14	6	$ 2,952	$ -	$ -
N/R	7	$ -	$ -	$ -
15	8	$ 7,747	$ 7,747	$ 23,241
Third Qtr		$ 75,113	$ 72,161	$ 223,158

Cost Share Portion				
Item No.	Task No.	Budgeted Amount	Current Amount	Cumulative Amount
1	1	$ 831	$ 831	$ 831
2	2	$ 51,654	$ 51,654	$ 51,654
3	3	$ 4,803	$ 4,803	$ 4,803
4	4	$ 307,539	$ 307,539	$ 307,539
5	5	$ 47,065	$ 47,065	$ 47,065
N/R	6	$ -	$ -	$ -
N/R	7	$ -	$ -	$ -
6	8	$ 4,242	$ 4,242	$ 4,242
First Qtr		$ 416,134	$ 416,134	$ 416,134
N/R	1	$ -	$ -	$ 831
7	2	$ 44,453	$ -	$ 51,654
8	3	$ 3,866	$ -	$ 4,803
9	4	$ 58,690	$ 58,690	$ 366,228
10	5	$ 37,426	$ 37,426	$ 84,491
N/R	6		$ -	$ -
N/R	7	$ -	$ -	$ -
11	8	$ 4,242	$ 4,242	$ 8,483
Second Qtr		$ 148,677	$ 100,357	$ 516,491
N/R	1	$ -	$ -	$ 831
N/R	2	$ -	$ -	$ 51,654
N/R	3	$ -	$ -	$ 4,803
12	4	$ 58,351	$ 58,351	$ 424,579
13	5	$ 26,439	$ 26,439	$ 110,930
14	6	$ 5,530	$ -	$ -
N/R	7	$ -	$ -	$ -
15	8	$ 4,242	$ 4,242	$ 12,725
Third Qtr		$ 94,561	$ 89,032	$ 605,523

The following items are not being invoiced for this reporting period:

- Item No. 7, Task No. 2 – Purchase and Characterize Pipe Material
- Item No. 8, Task No. 3 – Literature Review
- Item No. 14, Task No. 6 – Demonstration of Mechanical Damage Model Performance

Task 2-Material characterization (Quarter 1): Tensile tests, Charpy tests, Toughness tests on non-pre-strained material, and a part of pre-strains are done for Pipe 1. Toughness tests with pre-strain levels and cyclic tensile tests have to be conducted.
Task 2-Material characterization (Quarter 2): Tensile tests, Charpy tests, and Toughness tests on non-pre-strained material are done for Pipe 2. Pre-strain test, toughness with pre-strain levels and cyclic tensile tests have to be conducted. This task 2 is behind schedule due to the ongoing process of procuring a vintage pipe (Pipe 3) with low toughness. Due to the requirement of PRCI Project Team, an extra-work consisting to measure slip bands by Atomic Force Microscope is being added to the program (Cost $2,000 not taken into account in above table).
Task 3- Literature Review (Quarter 1): A literature review has been done on the pre-strain effect on toughness and on data on realistic defects from field feedback. This review will be updated from sources at future technical conferences, workshops, and from results of other PRCI projects.

Task 5- Testing of Dents with Gouges (Quarter 1): Defects 1.1.1, 1.1.2, 1.1.3, 1.2.1 and 2.1.1 were created and characterized (Mapping and Magnetic particles inspection). Burst test of defect 1.1.2 & Fatigue test on defect 1.1.3 done.

Task 5- Testing of Dents with Gouges (Quarter 2): Defects 1.2.2 and 2.1.2 were created and characterized (Mapping and Magnetic particles inspection). Burst tests on defects 1.2.2 and 2.1.2 done. Metallographic investigation after failure done for defects 1.1.2, 1.1.3. Fractographic examination has to be done.

Task 5- Testing of Dents with Gouges (Quarter 3): Defects 1.2.3 and 2.1.3 were created and characterized (Mapping and Magnetic particles inspection). Extra work of instrumenting them with strain gauges on the pipe inside below the defect, and recording the strain variation during defect creation was also performed[1]. Defects 1.1.1 and 1.2.1 which had been unwillingly submitted to pressure variations, and so were reproduced without additional costs for the Project Team (new defects called 1.1.1b and 1.2.1b). The instrumentation of defect 1.2.3 was performed after confirmation by the PRCI Project Team of the instrumentation plan. Metallographic investigation after failure was completed for defect 1.2.2. Fractographic examination has to be done.

Note: Determination of residual stresses on defects 1.1.1b, 1.2.1b and 2.1.1 has been deliberately delayed to save material permitting to create several defects in the same piece of pipe. Determination of residual stresses on defects 1.1.1b and 2.1.1b will be launched in the next months.

[1] The cost of the extra work related to internal strain gauges will be mentioned in the next progress report.