TECHNICAL MEMORANDUM 2

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Date: 11/30/2024	**Study No:** 0-7147 “Project Level Performance Database for Rigid Pavements in Texas, Phase Ⅲ”
To: 0-7147 Project Team	**Tech Memo No:** 0-7147 Technical Memorandum 2
From: 0-7147 Research Team	**Revision No.:** 0
Subject: Task 2. Continuation of Level 1 Section Evaluations	

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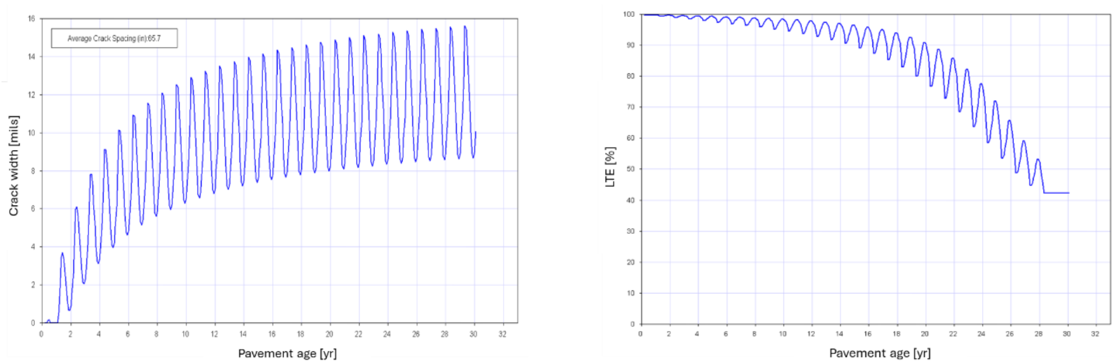
I. Introduction

The design, construction practices, and material selection criteria for Continuously Reinforced Concrete Pavement (CRCP) have evolved over time as more knowledge and experience have been accumulated. However, the structural responses of CRCP to environmental loading (temperature and moisture variations) as well as to wheel loading applications are quite complicated, especially the interactions between longitudinal steel and surrounding concrete under the wheel loading. Even though detailed knowledge exists on certain material properties, such as coefficient of thermal expansion (CTE) and drying shrinkage of concrete, the values of some of the properties in the field are not necessarily well and accurately known. For example, CTE is evaluated in the laboratory with concrete specimens fully saturated, while the concrete in CRCP is rarely fully saturated. The relationship between relative humidity (RH) and drying shrinkage is well established; however, estimating RH in CRCP through the slab depth is a real challenge. Additionally, theoretical analysis conducted during the development of TxCRCP-ME indicates that, during wheel loading applications, strong interactions occur between longitudinal steel and surrounding concrete, resulting in the maximum concrete stresses near the longitudinal steel, not at the bottom of the slab, as traditionally assumed in the research community. The strong interactions caused horizontal cracking in the concrete around steel near transverse cracks if the slab thickness is deficient for applied weights of the wheel loading. To fully and accurately analyze the CRCP behavior using theoretical models, values for the interface elements between steel and concrete need to be known. However, those values will never be accurately determined from experiments. Instead, it is customary to determine those values from sensitivity analysis as well as "backward computation," not traditional "forward computation." In addition to these challenges, there are other complexities of CRCP behavior that would easily compromise the accuracies of CRCP analysis results. One good example is the creep behavior of concrete in CRCP under the environmental loading. It is well known that concrete undergoes creep when the loading rate is quite slow, and the loading rate from temperature and moisture variations is quite small in CRCP. For example, daily concrete temperature variations near the slab surface are in the range of 20 to 40 °F, which is equivalent to approximately 1.7 to 3.3 °F/hour. For concrete with 5 microstrain/°F CTE and 5 million psi for modulus of elasticity, the equivalent loading rate for 3.3 °F/hour is about 83 psi per hour or 1.4 psi per minute. This loading rate quite small and under this loading rate, the concrete behaves as viscoelastic material with resulting creep in concrete. What makes the microscopic concrete behavior in CRCP more complicated is the reverse creep. In the morning, the concrete near the slab surface is in tension, while in the late afternoon, it is in compression, resulting in cyclic creep from tension to compression and residual creep. Currently, not much information is available in concrete creep in tension, let alone cyclic and residual creep, which makes the accurate analysis for concrete stresses for cracking behavior prediction in CRCP a formidable task. Accordingly, any attempt to predict CRCP behavior and long-term performance solely based on theoretical models has severe limitations. On top of that, long-term performance of CRCP is not necessarily dependent on crack spacing, unless cracking is quite out of norm. Unfortunately, in the research community, transverse crack characteristics, such as crack spacing and crack widths, were selected as a predictor for the long-term performance of CRCP. For example, the research work done under NCHRP 1-37(A) selected crack widths and associated LTE (load transfer efficiency) at cracks as a primary predictor for punchout development.

Figure 1 shows variations of predicted crack width and LTE over 30-year time period from the model developed in the NCHRP 1-37(A). It is shown that crack width increases over time, with resulting decrease in LTE, and eventual punchout. The variations within a given year are allegedly due to the temperature conditions during summer and winter.



(a) crack width *(b) LTE*

Figure 1 Predicted crack withs & LTE over time

In the early 2000s, TxDOT was planning to implement the product from the NCHRP 1-37(A), called MEPDG (Mechanistic-Empirical Pavement Design Guide) or AASHTO 2002 Design Guide at that time, which became now the AASHTOWare. To calibrate the MEPDG for Texas conditions, TxDOT sponsored the initial rigid pavement database project (TxDOT Research Project 0-5445: Sep 2005 to August 2008), the tasks of which included collecting information on CRCP behavior and performance. In this project, extensive field data, maybe the most in-depth and extensive CRCP dataset available, was collected. Since the increased crack width and resulting lower LTE were the primary punchout mechanisms in the MEPDG, field data collection was heavily towards the cracking and LTE evaluations. After several rounds of data collection, the research team was not able to duplicate the predictions from the MEPDG. So, the research team at that time tried to gather all available data and information on the crack widths vs LTEs; however, data from actual CRCP projects was quite limited, and those data that were available did not support the predictions from the MEPDG. In the initial rigid pavement database project, the selection of the CRCP sections was carefully developed so that the data collected would cover the whole spectrum of CRCP in Texas – pavement age, slab thickness, and geographic locations (weather conditions). Accordingly, the findings from the analysis of the dataset are considered valid and applicable throughout Texas, as long as the analysis method is correct. The research team accordingly concluded that the predictions from the MEPDG are not necessarily valid. When new models and/or equations are developed, it is customary to validate those with actual field data. For some unknown reasons, the crack width and LTE models in the MEPDG were not validated with field data. It appears that either the research team working on the MEPDG was prohibited from validating the models or the research team assumed that those models were accurate and did not need validations. Either way, the NCHRP 1-37(A) panel must have or should have required validations of the models.

As mentioned earlier, TxDOT was planning to implement the MEPDG and, in order to identify any additional testing needs for its implementation, TxDOT sponsored a research study, 0-4714 "Development of a Strategic Plan for the Implementation of the AASHTO 2002 Design Guide for TxDOT Operations." TTI conducted the research study and identified potential issues with the MEPDG, with the most significant being thicker slab required when stiffer base is used, which is counter intuitive. TTI research team recommended not to implement the MEPDG, and based on the recommendation, TxDOT sponsored a research project (TxDOT Research Project 0-5832: Sep 2008 to August 2010) to develop its own ME-based CRCP design program. This project required the development of a new transfer function, which correlates cumulative damage in concrete pavement to distress developments. Development of a transfer function needs extensive dataset, and to develop this data, the second rigid pavement database project (TxDOT Research Project 0-6275: Sep 2009 to August 2013) was initiated.

This third rigid pavement database project builds on the findings from the two earlier projects, representing the third phase in a continuing effort to collect field performance data on rigid pavements and further enhance CRCP design and performance. Now, almost 20 years after the initial 0-5445 project, this evaluation follows the same protocol to assess variations in slab deflections, LTEs, and other critical parameters over time. It includes an analysis of the results from the previous two projects, as well as an evaluation of the current performance of CRCP. By assessing CRCP sections over a longer period, this study aims to gain a more accurate understanding of long-term CRCP behavior and performance. The work performed in Task 2 of the research project followed the same field testing and data analysis protocol in the two previous rigid pavement database projects, so that consistency in the data collection and analysis is maintained, which will ensure the validity of the analysis results.

II. Evaluation Methodology

A. Description of FWD testing

The key equipment used in this evaluation is the Falling Weight Deflectometer (FWD), a non-destructive testing device commonly used to assess pavement structural performance (Bajorski & Irwin, 2018). The FWD simulates vehicle wheel loads, making it widely used in pavement engineering (Saleh, 2016). It operates by dropping a load plate from a set height onto the pavement surface and measuring the resulting deflection (Loulizi, Al-Qadi, & Elseifi, 2006). Typically, seven velocity transducers (geophones), spaced every 12 inches from the loading plate, capture the deflection. The load can be adjusted in multiple stages to simulate real traffic conditions.

FWD is extensively utilized in many areas of pavement engineering due to its versatility. Over time, various techniques have been developed to enhance its functionality, such as adjusting the position of geophones to obtain more precise measurements for different pavement structures. These adaptations allow the FWD to be applied to a wider range of pavement types, environments, and traffic conditions, ensuring that it remains an important tool in pavement analysis.

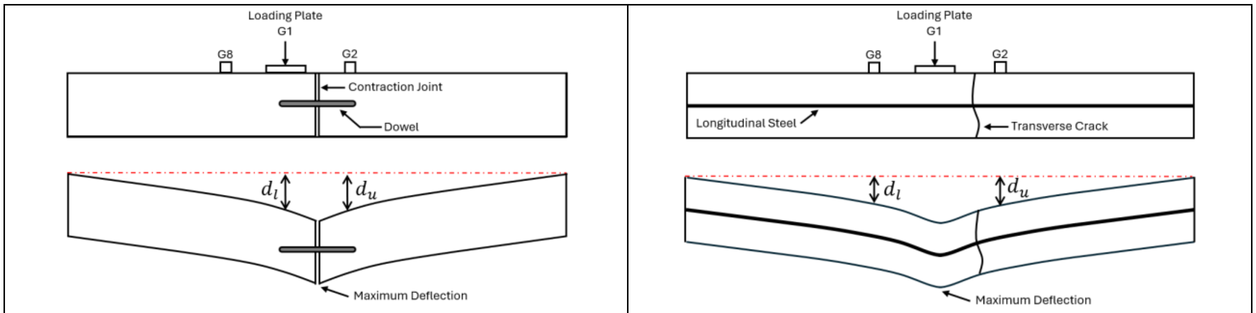
The data collected from these geophones is used to evaluate important performance factors such as LTE, modulus of subgrade reaction, the strength of the base materials, and the overall deflection of the slab (Jadhav & Naktode, 2022). This information is valuable for predicting pavement lifespan, developing maintenance strategies, and optimizing pavement design. Figure 2 shows the FWD operation in the field.

Figure 2 FWD Testing

B. Load Transfer Efficiency (LTE)

LTE is an important indicator in pavement engineering, used to evaluate the effectiveness of load transfer across joints or cracks in rigid pavements (Owusu-Anti, Meyer, & Hudson, 1990). It is defined as the ratio of deflection on the unloaded side of a joint or crack to the deflection on the loaded side, expressed as a percentage. Higher LTE values indicate better load transfer between pavement slabs, minimizing differential movement and stress concentrations, which can lead to better pavement performance.

LTE measurements differ between CPCD and CRCP due to the variations in deflection behavior. As shown in Figure 3, in CPCD, for instance, when a load is applied near a transverse joint, the maximum slab deflection occurs at the location of the transverse joint, not at the point where the load is applied. On the other hand, the transverse crack in CRCP is quite different from the contraction joint in CPCD in terms of structural continuity. In CRCP, the maximum deflection occurs exactly at the point of loading, regardless of the distance from the transverse crack. Longitudinal steel tightly holds the transverse cracks, resulting in a high degree of aggregate interlock. Additionally, many transverse cracks do not propagate through the full depth of the slab. Due to these characteristics, the slab behaves like a continuous slab, with the maximum deflection occurring at the location of the loading plate (Won & Medina-Chavez, 2008). Because of the difference in the location of the maximum deflection, in CPCD, the ratio between geophones G1 and G2 is used to calculate LTE, whereas in CRCP, LTE is measured using the position of G8 instead of G1. Equation 2.1 is used for calculating LTE for CPCD and CRCP, and in this evaluation, the LTE calculation equation for CRCP was applied. Figure 4 shows the LTE testing of the transverse crack in the upstream direction.



(a) CPCD	(b) CRCP

Figure 3 LTE Testing for CPCD & CRCP

$$LTE\ [\%] = \frac{d_u}{d_l} \times 100 \qquad (eq\ 2.1)$$

where, d_l = deflection of the loaded segment

d_u = deflection of the unloaded segment

Figure 4 LTE Testing at Transverse Crack

C. Section Information

In this evaluation, 10 sections were selected from the initially chosen sections across Texas, based on traffic and region, in the continuation of the two previous studies. Following the same protocol, CRCP was evaluated for slab deflection and LTE with FWD testing. The location and detailed information about the selected sections are shown in Figure 5 and Table 1.

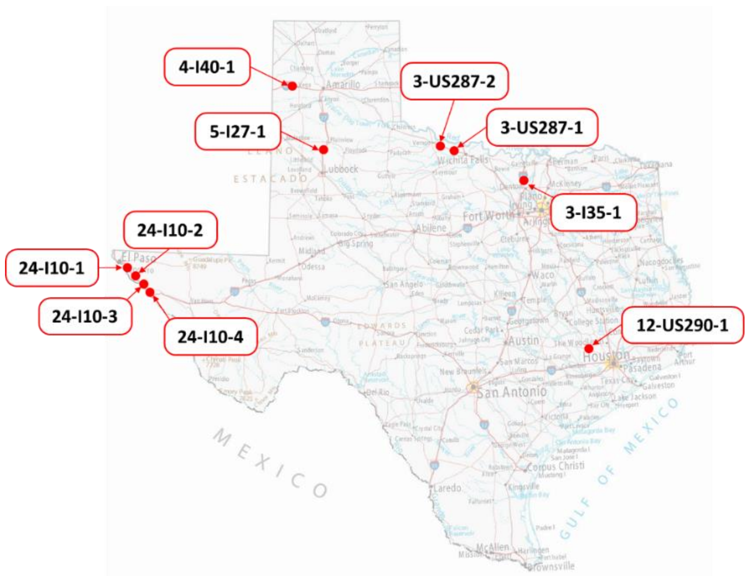


Figure 5 Section Locations

Table 1 Test Section Information

Section ID	District	Highway	Construction Year	Slab Thickness [in]
3-I35-1	Wichita Falls	IH 35	1991	10
3-US287-1	Wichita Falls	US 287	1970	8
3-US287-2	Wichita Falls	US 287	2003	10
4-I40-1	Amarillo	IH 40	2003	11
5-I27-1	Lubbock	IH 27	1982	9
12-US290-2	Houston	US 290	1996	10
24-I10-1	El Paso	IH 10	1998	13
24-I10-2	El Paso	IH 10	1998	13
24-I10-3	El Paso	IH 10	1998	13
24-I10-4	El Paso	IH 10	2003	12

Each section chosen was 1,000 feet long, with a TCJ located in the middle. FWD testing was conducted twice a year—once in the summer and once in the winter. The detailed experimental protocol is outlined in Figures 6 and 7, with deflection profiling performed at 50-foot intervals, followed by LTE evaluations at 12 cracks, 4 each for short, medium, and large crack spacing.

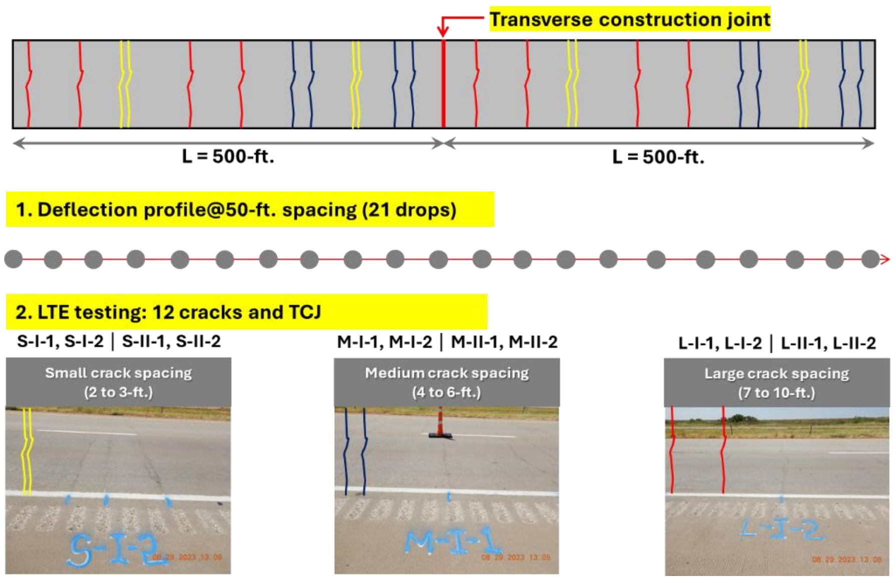


Figure 6 FWD & LTE testing protocol

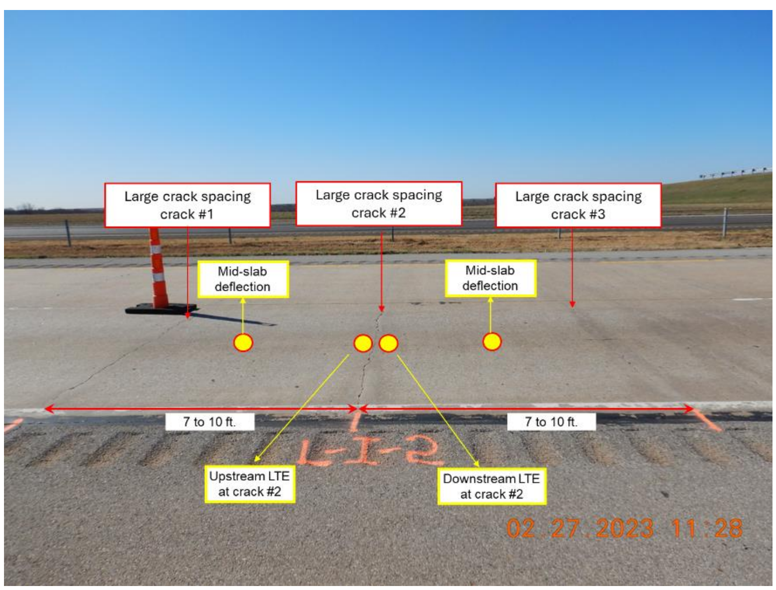


Figure 7 Detailed LTE testing protocol

D. Crack Spacing Measurements

In CRCP, transverse cracks are expected outcome, and should not be considered as distresses or pre-cursor for distresses. Unlike other pavement types, where cracking is generally viewed as distress, CRCP leverages controlled cracking to relieve concrete stresses that develop due to environmental loading. This controlled cracking approach helps the pavement maintain high LTE across cracks, supporting load transfers cross the cracks and resulting lower wheel load stresses which are supposed to increase the fatigue life of the pavement. Generally, in CRCP, the majority of the transverse cracks occur at early ages when environmental stresses are quite large due to drying shrinkage and large temperature variations from usually high concrete set temperatures, along with larger crack spacing. However, after few months to a year or two, environmental stresses decrease substantially and crack spacing is stabilized; in other words, an equilibrium condition is achieved where concrete stresses rarely exceed concrete strength, with few additional cracks. Even though recommended crack spacing for CRCP typically falls within the range of 3 to 6 feet (Roesler, Hiller, & Brand, 2016), it's been proven that crack spacing has little do to with CRCP performance, as long as those cracks are not out of norm; however, this "crack spacing is important for CRCP performance" caused confusions among both researchers and practitioners. It is because when more steel is used, crack spacing becomes smaller, since larger amount of steel restrains concrete volume changes more effectively, causing lager concrete stresses and more transverse cracks. On the other hand, less longitudinal steel will result in fewer cracks, and possibly those cracks could be in the so-called "recommended crack spacing." So, the question is, which one is better – less steel with fewer cracks or more steel with more cracks? It may take a while for this notion of "CRCP performance can be predicted by evaluating crack spacing" to be discarded, or it may never happen, considering how widely this concept has been accepted in the academia and research community.

For the field testing, cracks were classified into small (2-3 feet), medium (4-6 feet), and large (7-10 feet) spacings. Here, "small spacing" refers to slab segments containing a total of three consecutive cracks, with two adjacent transverse cracks having small crack spacing. The same logic applies to the medium and large crack spacing categories. For each crack of interest, a total of FWD drops were made at 4 locations – at mid-slab, upstream of the crack (this crack is the middle one of the 3 consecutive cracks), downstream of the crack, and at mid-slab. In this project, the FWD testing was conducted on the very same cracks selected and evaluated in the first and second phases of the rigid pavement database projects (0-5445 and 0-6274). The objective of this field testing was to evaluate variations of deflections and LTE over almost 20 years.

III. Results

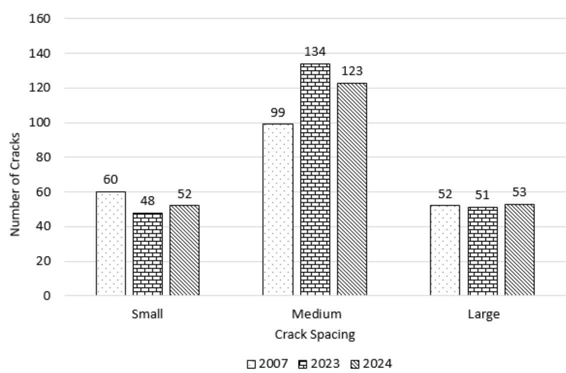
A. Crack Spacing

The results of the crack spacing measurement are illustrated in Table 2. The crack spacing data analysis shows that some of the sections have closely spaced cracks while others have larger crack spacings. For instance, Sections 2006 5-I27-1 and 2024 5-I27-1 had a significant number of cracks in the small spacing category, with 266 and 196 cracks, respectively. This suggests that these areas likely experienced large temperature swings at early ages and/or concrete with larger CTE. In contrast, Sections such as 2024 24-I10-2 and 2006 2-I35W-1 had only 6 and 13 cracks in the small spacing range.

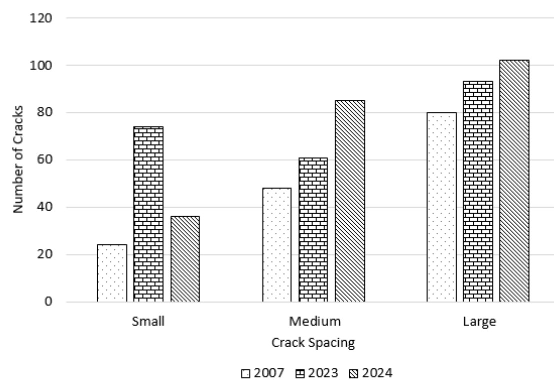
Table 2 Number of cracks recorded in the test sections

Section ID	Measured Year	Crack Spacing			Total
		Small	Medium	Large	
2-I35W-1	2006	13	75	78	166
3-I35-1	2007	114	133	27	274
3-US287-1	2007	60	99	52	211
	2023	48	134	51	233
	2024	52	123	53	228
3-US287-2	2007	24	48	80	152
	2023	74	61	93	228
	2024	36	85	102	223
5-I27-1	2006	266	110	8	384
	2023W	207	166	9	382
	2023 S	207	159	12	378
	2024	196	173	9	378
4-I40-1	2006	99	149	87	335
	2023	54	126	55	235
	2024	39	133	61	233
12-US290-1	2024	167	186	13	366
24-I10-2	2024	6	42	92	140
24-I10-3	2024	106	76	63	245

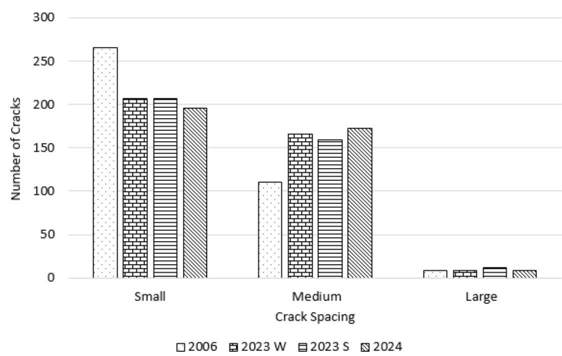
The data in Table 2 shows that crack development in the sections generally stabilized over time, consistent with the expected behavior of CRCP. However, in several sections, the total number of cracks actually decreased. Obviously, there were some errors in crack measurements. Since the transverse cracks open up in the cold weather, it is easier to detect cracks than when it is hot. Also, transverse tining obscures transverse cracks, making accurate count of transverse cracks a somewhat challenge. The fact that cracks are so tight that researchers apparently missed some cracks is a good thing, as far as structural capacity of CRCP is concerned, because those tight cracks are mostly partial-depth cracks, the cracks that stop within few inches from the concrete surface. Figure 8 presents the data in Table 2 in graphic format.



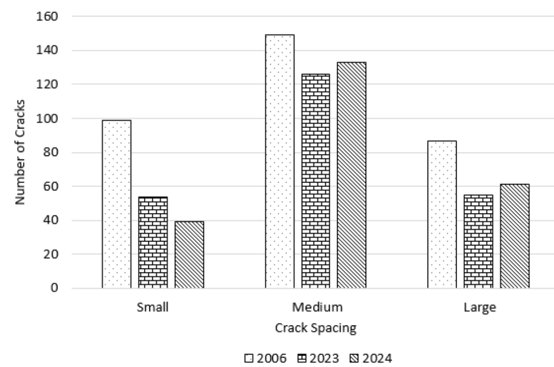
(a) 3-US287-1



(b) 3-US287-2



(c) 5-I27-1



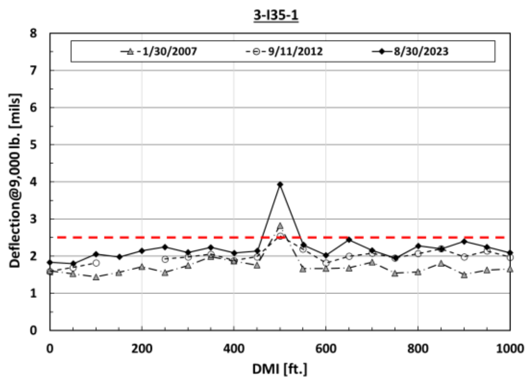
(d) 4-I40-1

Figure 8 Crack spacing variation over time

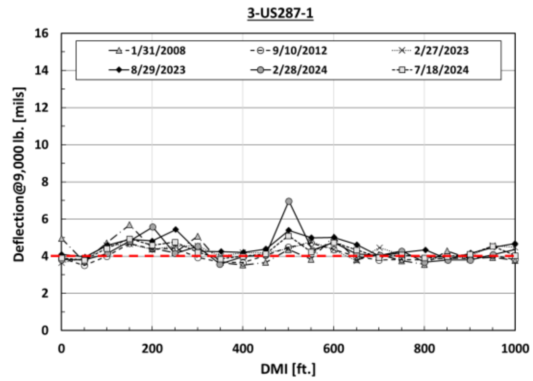
B. Slab Deflection

As previously stated, CRCP sections were evaluated by slab deflections using the FWD. A total of 10 test sections were evaluated over a span of three years, with tests conducted at 50-foot intervals. Figure 9 shows the deflection values measured for each section, as well as the deflections including those obtained from the two previous database studies to evaluate deflection variations over time. The red dotted line indicates the statewide average deflection in Texas for the slab thickness. It is shown that the deflections are close to the state-wide average values for given slab thicknesses, except for two sections (c) 3-US287-2 and (d) 4-I40-1. This discrepancy is discussed later.

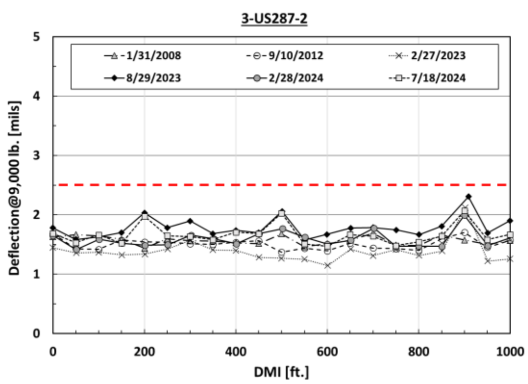
Overall observations are that the slab deflections over time are quite stable. There are some exceptions. In Section 24-I10-4, deflections were the smallest on May 26, 2023, while the largest deflections were recorded on February 1, 2007, after almost 16 years. Even though there might have been factors other than pavement age that contributed to this decrease in slab deflections over time, the difference is somewhat large, indicating that there might have some issues with the accuracy of geophones in the FWD units used in 2007 and/or 2023. This type of data raises a concern for the validity of the deflection data obtained at different times or with different FWD units. To address this issue, TxDOT requires every FWD unit to be calibrated once per year. However, it appears that the quality assurance program for FWD did not prevent this issue. Still, valid observations can be made: (1) overall, deflections at transverse construction joints (500-ft location) are larger than those at other areas, and (2) larger deflections at other than TCJs were primarily due to the full-depth repairs of the slabs.



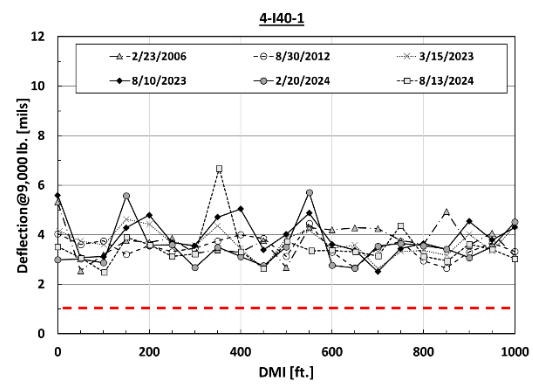
(a) 3-I35-1



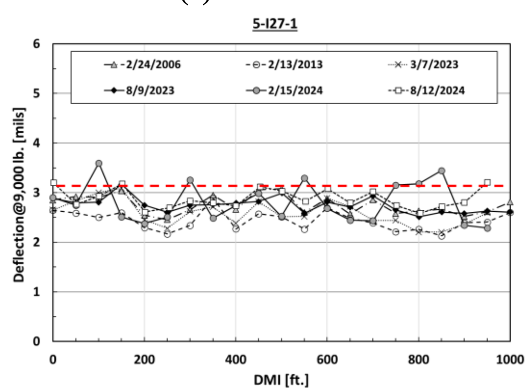
(b) 3-US287-1



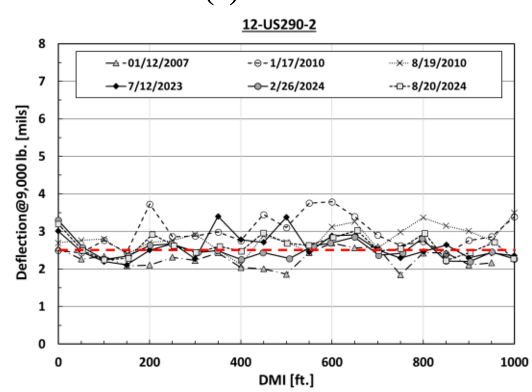
(c) 3-US287-2



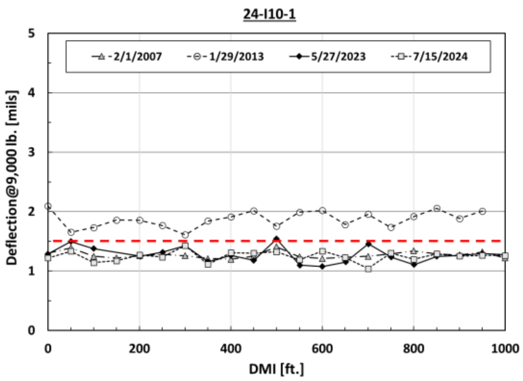
(d) 4-I40-1



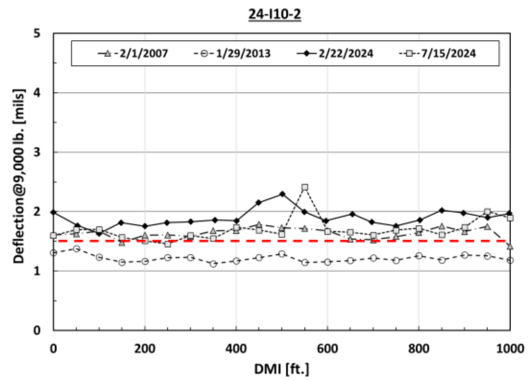
(e) 5-I27-1



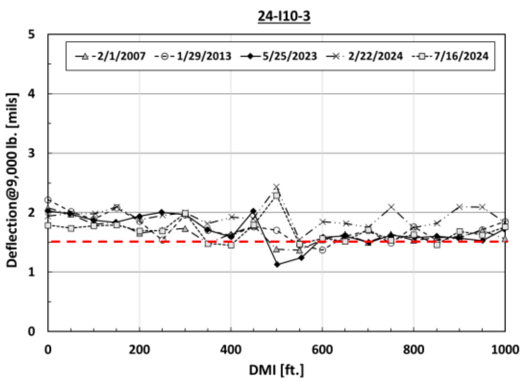
(f) 12-US290-2



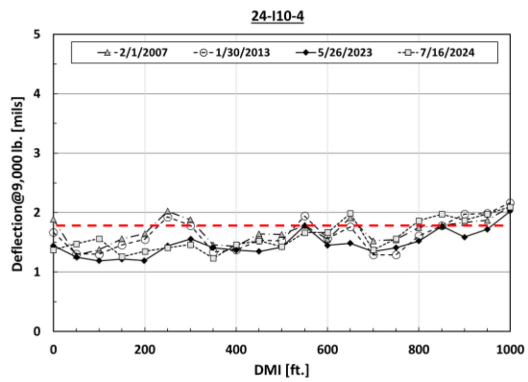
(g) 24-I10-1



(h) 24-I10-2



(i) 24-I10-3



(j) 24-I10-4

Figure 9 Deflection profile over time

Another notable observation is that, with the exception of Sections 3-US287-2 and 4-IH40-1, the deflection values were similar to the statewide average in Texas. In Section 3-US287-2, the deflection values are much smaller than the statewide average. Although the design slab thickness for this section was 10 inches, the two cores taken showed thicknesses of 10.50 inches and 10.75 inches, respectively. Additionally, this section was identified as an unbonded concrete overlay (UBCO) section, with 8 inches of CRCP below the 10-inch slab as shown in Figure 10. This strong CRCP layer as a base likely explains the smaller deflection values. In contrast, the deflections in 4-IH40-1 Section were much larger than the statewide average. This 13-inch CRCP had numerous map cracks, as shown in Figure 11, and TxDOT conducted an evaluation to determine the cause of these cracks. The evaluation concluded that the cracks were caused by Alkali-Silica Reaction (ASR). The extensive network of ASR cracks likely contributed to micro-cracking in concrete, resulting in larger slab deflections.

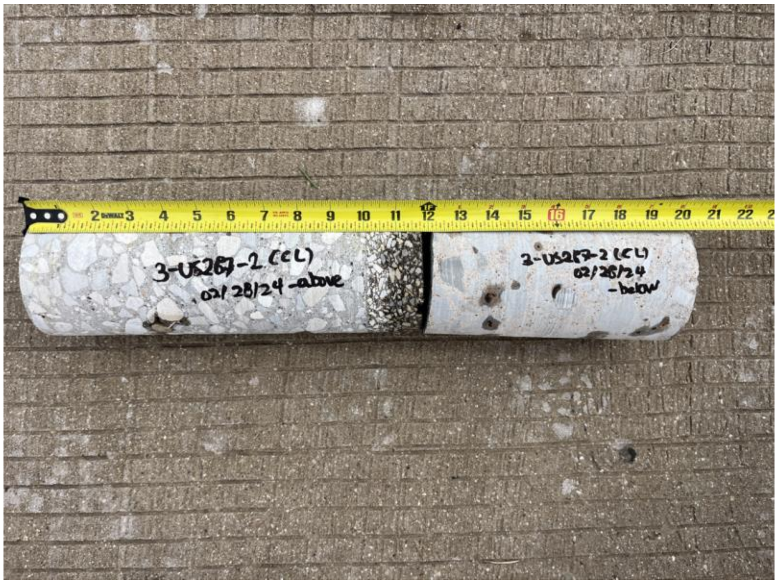


Figure 10 Coring sample from UBCO section (3-US287-2)

Figure 11 ASR Section (4-I40-1)

Another effort was made to evaluate the material properties of concrete. The most widely accepted theory regarding long-term CRCP behavior and performance is that traffic loads cause fatigue damage in the form of micro-cracks in the concrete, reducing the modulus of elasticity of concrete, which will increase slab deflections. Researchers tried to identify any microcracks in the concrete cores. Even though the effort was via visual observations, no microcracks were observed, with one core shown in Figure 12.

Figure 12 Coring Sample (3-US287-1)

C. LTE at Transverse Cracks

In this study, LTE was evaluated on the same cracks that were selected for LTE evaluations in the first 2 database projects, which allowed an assessment of how traffic and pavement age impact LTE. Figure 13 shows the LTE values evaluated over approximately 16 years for each section. As can be seen, little variations are observed over 16 years. More importantly, LTE values all have been maintained at almost 100 percent level. In other words, the condition of the cracks evaluated has not changed over 16 years. Section-by-section LTE values are shown in Figure 14, with all the testing results provided in the Appendix A.

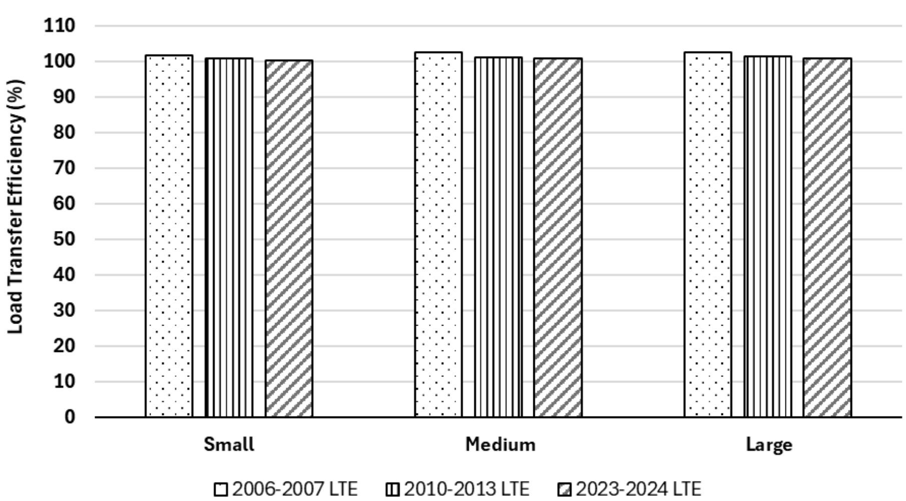
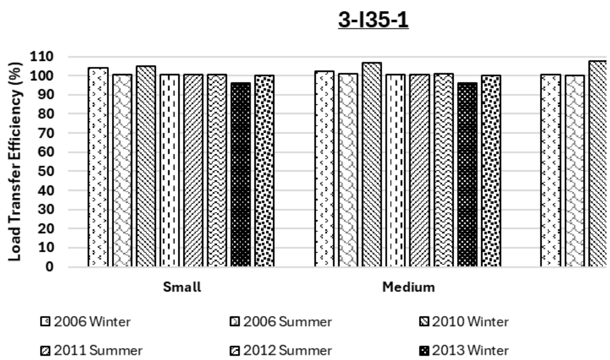


Figure 13 Average LTE over time with different crack spacing



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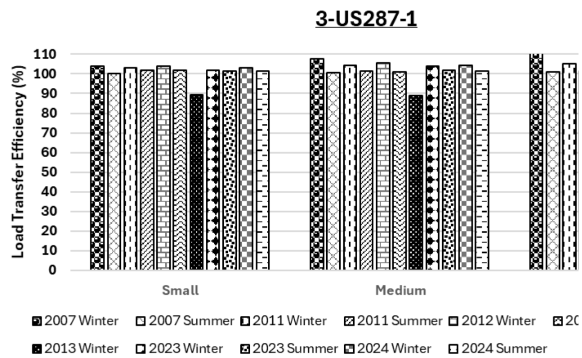
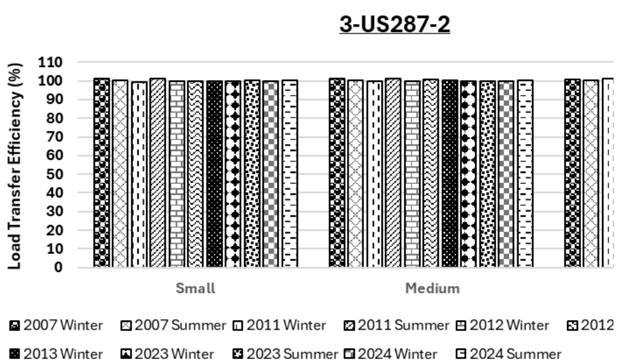
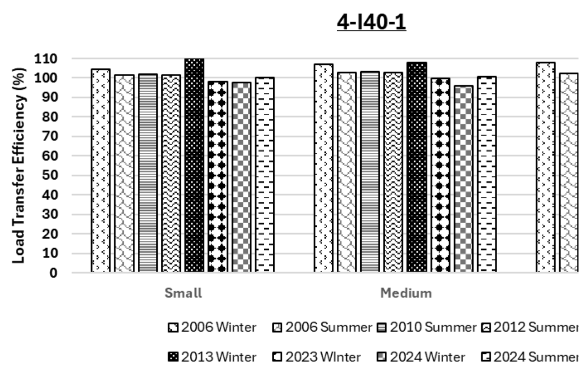


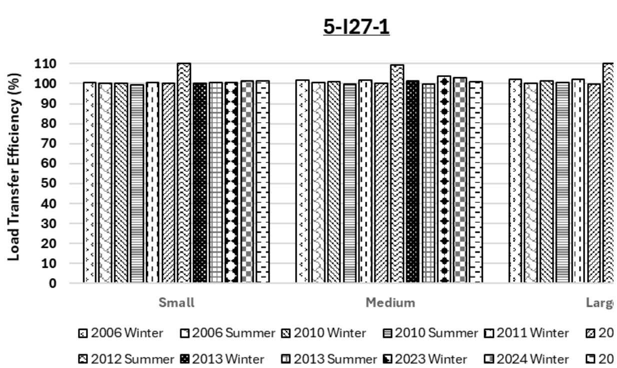
(b) 3-US287-1



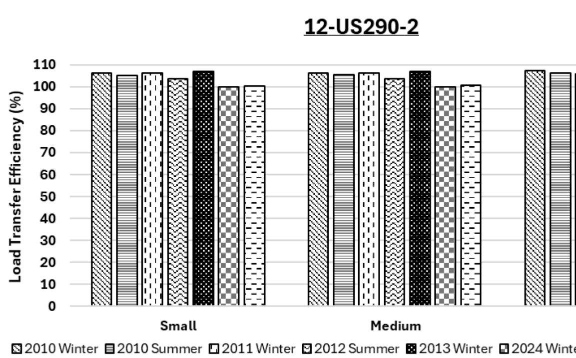
(c) 3-US287-2



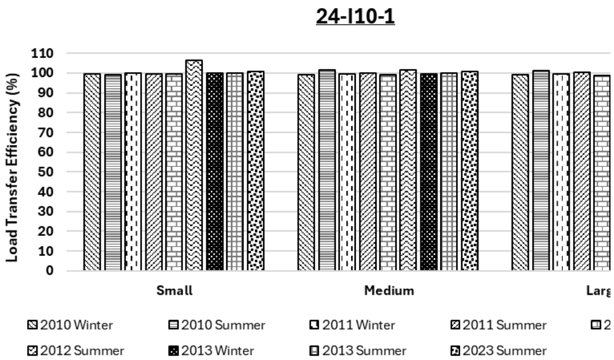
(d) 4-I40-1



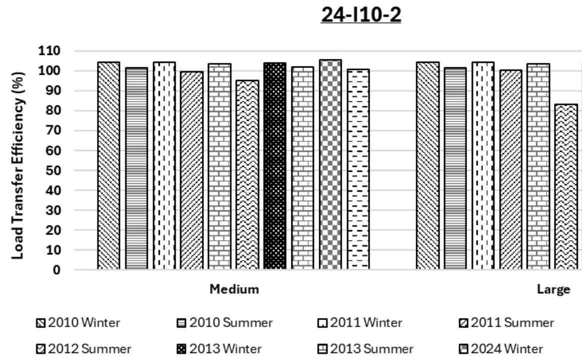
(e) 5-I27-1



(f) 12-US290-2



(g) 24-I40-1



(h) 24-I40-2

Figure 14 LTE over time in each test section

In Figure 14, it is noted that LTEs have been almost 100 percent, regardless of crack spacing, season of testing (temperature effect), or age. Even though accurate evaluations of the variations in slab deflections over time are a challenge due to potential variance in geophones among the FWD units, the same concern does not exist for LTE evaluations, since only one FWD unit was used to evaluate LTEs and variability in geophone accuracies among FWD units is not a concern anymore. This near 100 percent LTE indicates real continuity in concrete slabs cross transverse cracks. Figure 15 illustrates how deep a transverse crack penetrates in CRCP. This example from US 290 in Houston shows that, although the surface crack appears large, it disappears in the middle third of the slab. At this crack, LTE should be 100% since it’s not only the steel that is continuous but the concrete is also “continuous.” In this sense, the name of the pavement should be “Continuously Reinforced and Continuous Concrete Pavement,” or CRCCP.

Figure 15 Transverse crack characteristics

Figure 16 presents average LTEs at all 10 sections evaluated in this study. Again, regardless of crack spacing and temperature conditions, LTEs were almost 100 percent. Figure 17 illustrates almost identical LTEs for upstream and downstream, with again almost 100 percent LTEs. What this data means is that transverse cracks evaluated in this study were structurally "equivalent" to continuous concrete slab. This finding is contradictory to the LTE model in MEPDG, where LTE values vary depending on the season. The assumption in the MEPDG model is that crack widths change depending on the temperature – larger crack widths in the winter and smaller ones in the summer, and thus larger LTEs in the summer and larger LTEs in the summer. It is unfortunate that the model was not calibrated with field data.

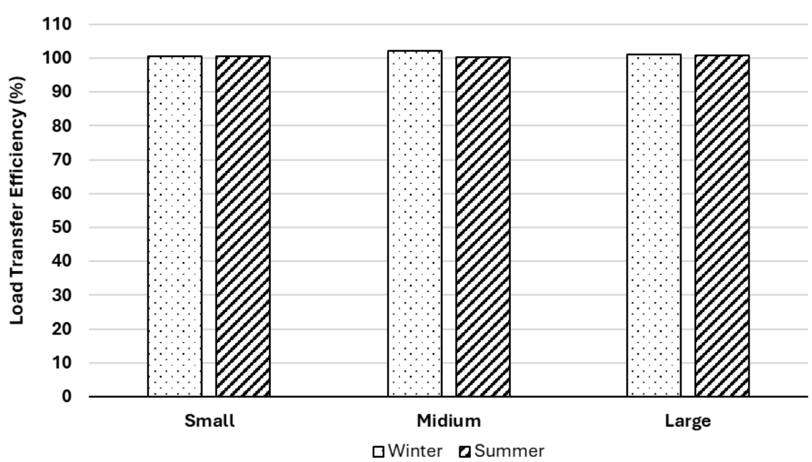


Figure 16 LTE with different seasons

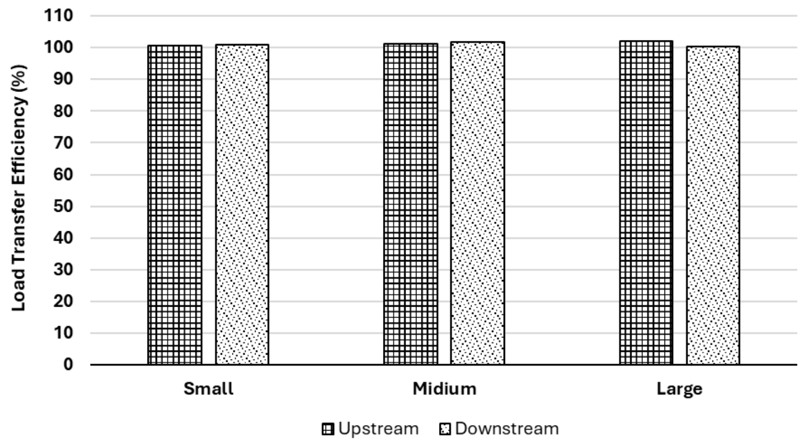


Figure 17 LTE with different loading location

Additionally, some data shows LTE values over 100%. Obviously, LTE cannot be greater than 100%. Variations in sensor sensitivity, accuracy, the condition of the concrete surface, and potentially the shape of crack propagation through the depth could sometimes result in measurements slightly above 100%. Table 3 displays the deflections measured at the second geophone (G2) and the eighth geophone (G8), with both G2 and G8 located 12 inches from the center of the loading plate. In this case, both G2 and G8 were in the same slab segment, i.e., within two transverse cracks with the loading plate right in the middle of the two transverse cracks. Ideally, if the sensors were in perfect condition and the slab behaved symmetrically as it is supposed to, the deflections at G2 and G8 should have been the same, but as shown in Table 3, they were not in most cases. This means that LTE values may vary slightly above or below 100%, which explains LTE values greater than 100% in the field testing.

Table 3 Deflections from G1 & G8

FWD Testing Equipment From	Section	Sensor No. & Measured Deflection [mils]	
		G8	G2
Dallas	3-I35-1	1.95	1.96
	3-US287-1	3.91	3.91
	3-US287-2	1.46	1.48
	Average	2.44	2.45
El Paso	24-I10-1	1.12	1.14
	24-I10-3	1.50	1.53
	24-I10-4	1.34	1.37

	Average	1.32	1.35

Efforts were also made to identify previous studies on LTEs in CRCP. Figure 18 presents the only available data on crack spacing and LTE from the Long-Term Pavement Performance (LTPP) database (Tayabji, Selezneva, & Jiang, 1999). The data shows that 96% of the evaluated cracks (48 out of 50 data points) had LTE values above 90%, consistent with the results of this study. What is interesting is that there is a somewhat positive correlation between crack spacing and LTE – the larger the crack spacing, the greater the LTEs. This finding is somewhat different from the measurements made in this research study. In this study, crack spacing did not have any effect on LTEs. Still, it is to be noted that in the MEPDG, crack spacing is considered a key factor influencing LTEs, since crack widths are, in the MEPDG model, almost linearly proportional to crack spacing. In other words, the larger the crack spacing, the larger the crack width and the smaller the LTEs. Figure 18 shows somewhat the opposite trend. The research team believes that the trend shown in Figure 18 is not accurate, even though that does not mean the LTE model in the MEPDG is valid. Accurate LTE evaluations require very careful field testing. Ideally, the loading plate should be located right at the crack. If not, the accuracy of LTE will suffer.

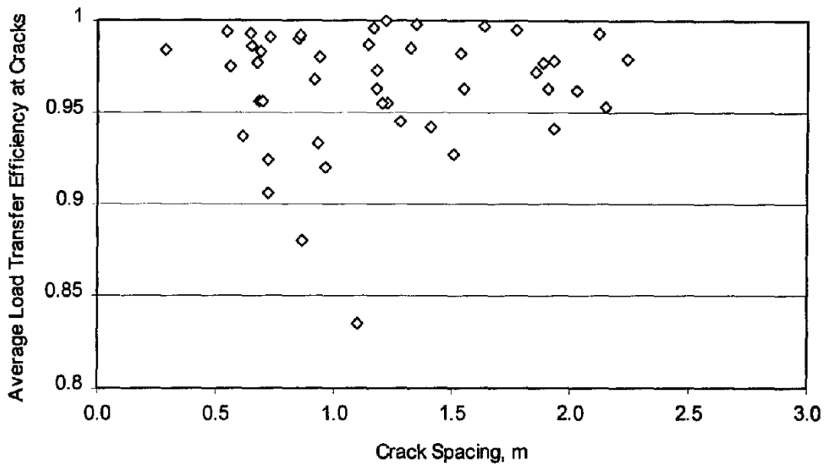
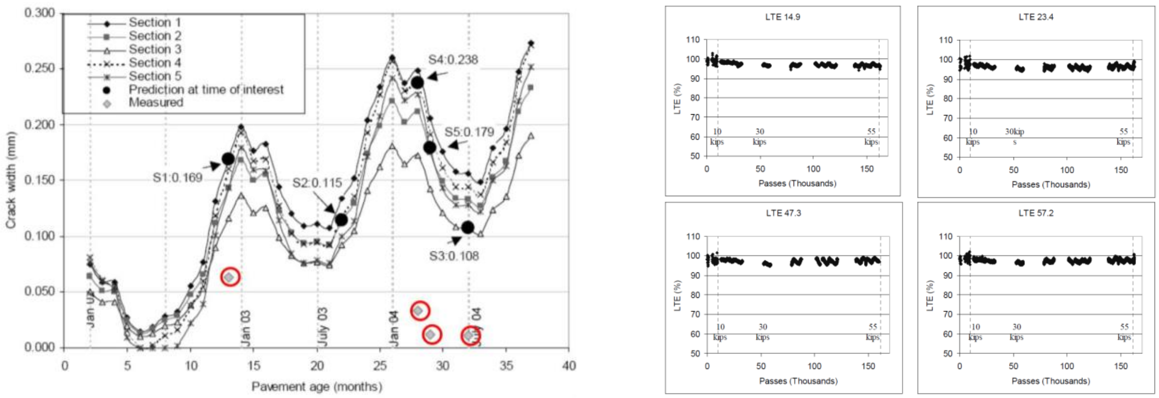


Figure 18 Average LTE at cracks versus crack spacing (Tayabji, Selezneva, & Jiang, 1999)

Additionally, a study conducted in Illinois compared measured crack widths with those predicted from the MEPDG, along with the corresponding LTE measurements (Kohler, 2005). Figure 19(a) illustrates two key findings: (1) the MEPDG predicted that crack widths would increase over time and fluctuate seasonally, which is consistent with the discussions made at the beginning of this memorandum, and (2) it significantly overestimated crack widths, predicting values 10 to 15 times larger than the actual measurements. Figure 19(b) shows LTE values over various number of truck axle load applications. It shows practically no changes in LTE over 160,000 axle applications, which is another evidence that transverse cracks do not present weak elements in CRCP.



(a) Crack width from MEPDG & measured *(b) LTE*

Figure 19 Crack width evaluation b/w prediction & field, and LTE (Kohler 2005)

Nam (2005) reported that the crack width of CRCP constructed on US 183 in Austin decreased over time, as shown in Figure 20. In Nam's study, crack width was estimated from vibrating wire strain gauges (VWSG) embedded in induced transverse cracks, offering more accurate measurements than the visual observations. Although the exact cause of the decrease in crack width is not fully understood, it may be attributed to the development of additional transverse cracks, the progressive stress redistribution within the concrete, as well as long-term creep of concrete. This data is contradictory to the predictions from the MEPDG, where crack width increases over time. This discrepancy needs to be resolved.

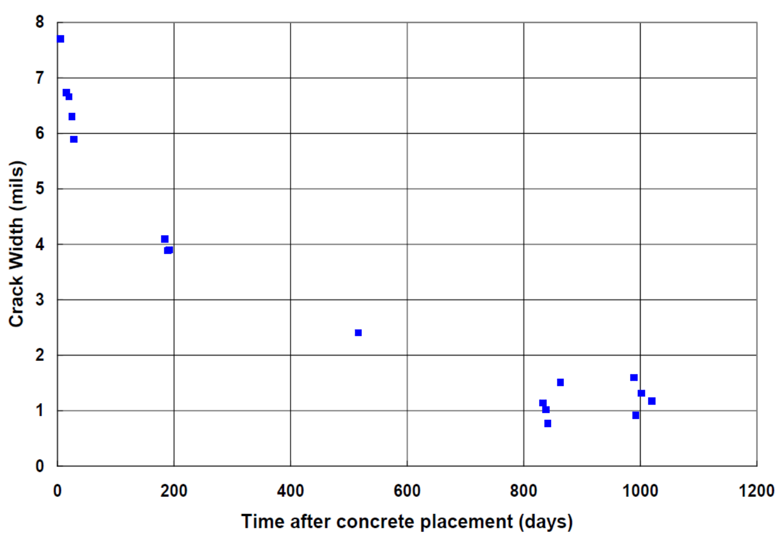


Figure 20 Measured crack widths over time (Nam 2005)

IV. Updating Statewide Deflections in Texas

Statewide deflection profile was developed in the previous projects, 0-5445 and 0-6274, as shown in Figure 21. This profile has played a key role in setting a benchmark for deflection values across Texas. The dataset was developed by collecting extensive deflection data from CRCP sections across various climatic regions, traffic loads, and pavement ages.

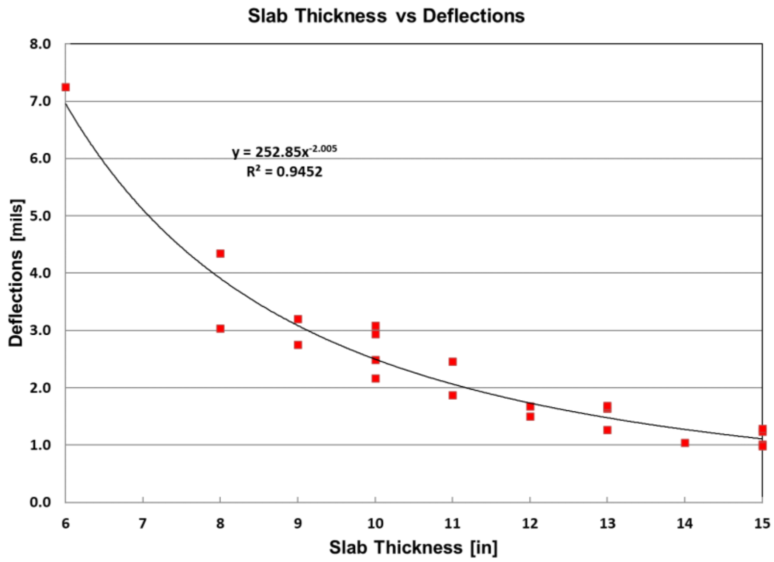


Figure 21 Statewide Deflection with different CRCP thickness (0-6274)

In this study, a new deflection profile from recent tests has been integrated to update the statewide deflection profile, which was developed in the previous 2 projects. Additionally, this update addressed discrepancies found in section information from prior studies. In cases where the information was found to be inaccurate, plansets were reviewed and corrected. Moreover, sections which had some issues or rehabilitation such as concrete overlay or ASR were excluded from the updated analysis. This update also included deflection values from other sources such as forensic evaluations conducted across Texas. By integrating data from multiple sources, the updated statewide deflection profile now provides a more comprehensive representation of the deflections. Table 4 provides a list of the evaluated sections.

Table 4 Section information

Section ID	District	Highway	Thickness [in.]
2-I35-1	Fort Worth	IH 35	13
3-I35-1	Wichita Falls	IH 35	10
3-US287-1	Wichita Falls	US 287	8
5-I27-1	Lubbock	IH 27	9
5-LP289-1	Lubbock	Loop 289	10

9-I35-2	Waco	IH 35	15
12-US290-1	Houton	US 290	10
12-US290-2	Houton	US 290	10
12-441-1	Houton	IH45	15
12-441-2	Houton	IH45	15
18-I30-1	Dallas	IH 30	13
19-US59-1	Atlanta	US 59	12
19-US59-2	Atlanta	US 59	12
20-I10-1	Beaumont	IH 10	15
24-I10-1	El Paso	IH 10	13
24-I10-2	El Paso	IH 10	13
24-I10-3	El Paso	IH 10	13
24-I10-4	El Paso	IH 10	12
25-I40-2	Childress	IH 40	12

The results of this comprehensive analysis, as shown in Figure 22, demonstrate strong similarities with the previously developed statewide deflection profiles. This consistency shows the reliability of the profile as a reference for deflection behavior in CRCP. One observation is the variation in deflection for slabs with a thickness of 10 inches, where the deflection variation reaches approximately 1 mil. This suggests that, despite the same slab thickness, variations in the base structures or subgrade may have influenced the deflection.

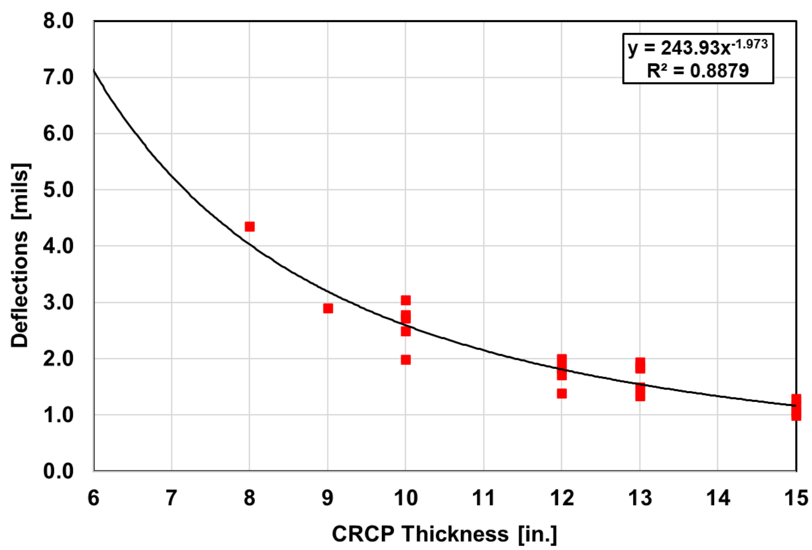


Figure 22 Updated statewide deflections with different CRCP thickness

V. Summary

The objective of this technical memorandum was to document the field data obtained in this research study. Obtaining accurate field data on CRCP behavior is a real challenge, which may explain the scarcity of this type of data, and the lack of calibration of the models in the MEPDG. As discussed in the body of the memorandum, the dataset obtained in this study has many technical implications, which could help set the right direction for future CRCP research and design practices. Those implications will be fully discussed during the PMC meeting, and documented in the final report of this project.

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Appendix A

Long-Term Load Transfer Efficiency (LTE) Evaluation by Section

Section I.D.: 3-I35-1

Date: 8/30/2023

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S-1-1	Upstream	1.75	2.04	1.80	1.53	1.27	1.03	0.82	0.68	103
	Downstream	1.78	2.11	1.81	1.52	1.25	1.01	0.79	0.65	98
M-1-1	Upstream	1.85	2.07	1.90	1.68	1.43	1.25	1.07	0.88	103
	Downstream	1.88	2.15	1.95	1.74	1.47	1.24	1.12	0.91	97
L-1-1	Upstream	1.88	2.16	1.90	1.70	1.49	1.29	1.11	0.95	101
	Downstream	1.87	1.98	1.90	1.67	1.47	1.25	1.08	0.90	98
S-1-2	Upstream	2.18	2.44	2.17	1.85	1.51	1.28	1.04	0.87	99
	Downstream	2.15	2.37	2.08	1.80	1.50	1.26	1.08	0.92	103
M-1-2	Upstream	1.89	2.25	1.94	1.70	1.45	1.24	1.05	0.88	103
	Downstream	1.92	2.20	2.00	1.73	1.51	1.27	1.19	0.91	96
L-1-2	Upstream	2.02	2.20	2.03	1.78	1.53	1.33	1.15	1.00	100
	Downstream	1.99	2.22	1.99	1.74	1.54	1.33	1.15	1.01	100
S-2-1	Upstream	2.18	2.45	2.13	1.89	1.62	1.39	1.26	1.06	98
	Downstream	2.08	2.35	2.09	1.84	1.59	1.41	1.09	1.04	100
M-2-1	Upstream	1.92	2.12	1.95	1.76	1.55	1.38	1.23	1.06	101
	Downstream	1.91	2.05	1.97	1.79	1.57	1.38	1.23	1.06	97
L-2-1	Upstream	2.01	2.30	2.08	1.84	1.59	1.44	1.23	1.07	103
	Downstream	2.01	2.26	1.98	1.74	1.51	1.38	1.21	1.03	101
S-2-2	Upstream	2.16	2.35	2.23	1.98	1.71	1.45	1.25	1.07	103
	Downstream	2.20	2.42	2.26	1.99	1.67	1.44	1.23	1.06	97
M-2-2	Upstream	1.97	2.18	1.97	1.75	1.55	1.36	1.23	1.06	100
	Downstream	1.97	2.16	1.96	1.77	1.51	1.39	1.33	1.05	100
L-2-2	Upstream	2.11	2.27	2.12	1.82	1.50	1.27	1.10	0.93	100
	Downstream	2.10	2.39	2.04	1.76	1.46	1.26	1.11	0.93	103

Section I.D.: 3-US287-1

Date: 2/27/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	3.61	3.92	3.68	3.03	2.43	2.00	1.58	1.18	102
	Downstream	3.65	3.89	3.46	3.06	2.52	1.98	1.57	1.25	106
M-1-1	Upstream	3.51	3.86	3.63	3.08	2.41	1.95	1.68	1.25	103
	Downstream	3.71	3.92	3.47	2.98	2.41	1.96	1.53	1.15	107
L-1-1	Upstream	3.96	4.23	4.29	3.61	2.85	2.22	1.77	1.34	108
	Downstream	4.24	4.47	3.96	3.39	2.77	2.21	1.78	1.31	107
S-1-2	Upstream	3.97	4.45	4.20	3.54	2.86	2.28	1.80	1.41	106
	Downstream	4.25	4.44	4.07	3.57	2.90	2.30	1.83	1.37	104
M-1-2	Upstream	4.01	4.32	3.94	3.39	2.75	2.20	1.76	1.46	98
	Downstream	4.00	4.27	3.94	3.38	2.74	2.20	1.76	1.33	101
L-1-2	Upstream	3.82	4.17	4.03	3.39	2.72	2.25	1.86	1.38	106
	Downstream	4.00	4.17	3.86	3.30	2.74	2.25	1.89	1.51	104
S-2-1	Upstream	4.33	4.57	4.33	3.64	2.96	2.33	1.83	1.40	100
	Downstream	4.30	4.54	4.22	3.57	2.89	2.31	1.86	1.41	102
M-2-1	Upstream	4.07	4.31	4.23	3.63	2.99	2.36	1.90	1.56	104
	Downstream	4.21	4.38	4.06	3.53	2.99	2.42	1.96	1.53	104
L-2-1	Upstream	4.05	4.39	4.28	3.62	3.01	2.50	2.02	1.61	106
	Downstream	4.18	4.45	4.13	3.53	2.98	2.49	2.13	1.58	101
S-2-2	Upstream	3.73	3.94	3.84	3.22	2.57	2.03	1.68	1.25	103
	Downstream	3.82	4.04	3.74	3.19	2.54	2.02	1.58	1.25	102
M-2-2	Upstream	3.52	3.90	3.68	3.07	2.49	1.96	1.53	1.19	105
	Downstream	3.68	3.84	3.48	2.98	2.40	1.88	1.53	1.19	106
L-2-2	Upstream	3.64	4.09	3.83	3.16	2.53	1.99	1.59	1.20	105
	Downstream	3.79	4.05	3.63	3.02	2.45	1.96	1.56	1.17	104

Section I.D.: 3-US287-1

Date: 8/29/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	3.52	4.13	3.52	2.88	2.29	1.78	1.36	1.03	100
	Downstream	3.75	4.07	3.66	3.09	2.47	2.04	1.65	1.31	102
M-1-1	Upstream	3.50	3.90	3.60	3.02	2.49	2.03	1.63	1.23	103
	Downstream	3.59	4.02	3.56	3.04	2.47	2.02	1.65	1.34	101
L-1-1	Upstream	3.99	4.50	4.03	3.42	2.79	2.22	1.72	1.31	101
	Downstream	4.06	4.50	4.03	3.47	2.80	2.25	1.81	1.38	101
S-1-2	Upstream	3.94	4.45	4.03	3.37	2.76	2.22	1.79	1.41	102
	Downstream	4.04	4.30	3.90	3.33	2.73	2.21	1.75	1.39	104
M-1-2	Upstream	4.15	4.63	4.20	3.61	2.99	2.42	1.91	1.54	101
	Downstream	4.15	4.56	4.17	3.63	2.97	2.41	1.93	1.50	100
L-1-2	Upstream	3.90	4.44	4.03	3.43	2.81	2.31	1.89	1.48	103
	Downstream	4.02	4.35	3.99	3.41	2.82	2.31	1.82	1.40	101
S-2-1	Upstream	4.32	4.77	4.28	3.68	3.02	2.44	1.97	1.56	99
	Downstream	4.27	4.73	4.22	3.65	3.02	2.43	1.97	1.59	101
M-2-1	Upstream	4.24	4.57	4.28	3.68	3.08	2.51	2.07	1.64	101
	Downstream	4.26	4.68	4.27	3.68	3.13	2.53	2.06	1.69	100
L-2-1	Upstream	4.22	4.83	4.26	3.72	3.14	2.60	2.13	1.71	101
	Downstream	4.25	4.58	4.21	3.67	3.08	2.58	2.09	1.70	101
S-2-2	Upstream	3.76	4.28	3.83	3.22	2.61	2.07	1.67	1.32	102
	Downstream	3.81	4.22	3.78	3.19	2.58	2.07	1.60	1.26	101
M-2-2	Upstream	3.66	4.21	3.76	3.14	2.55	2.01	1.57	1.24	103
	Downstream	3.73	4.14	3.64	3.07	2.48	1.98	1.54	1.26	103
L-2-2	Upstream	3.61	4.30	3.70	3.07	2.50	1.97	1.56	1.19	102
	Downstream	3.67	4.05	3.54	3.01	2.41	1.94	1.54	1.26	104

Section I.D.: 3-US287-1

Date: 2/28/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	3.52	3.93	3.68	2.98	2.34	1.85	1.45	1.12	104
	Downstream	3.63	3.92	3.57	3.03	2.39	1.85	1.45	1.11	102
M-1-1	Upstream	3.48	4.01	3.75	3.07	2.41	1.88	1.47	1.14	108
	Downstream	3.69	4.02	3.55	2.96	2.37	1.87	1.49	1.18	104
L-1-1	Upstream	4.12	4.70	4.47	3.68	2.90	2.24	1.68	1.23	108
	Downstream	4.38	4.74	4.22	3.51	2.77	2.14	1.60	1.23	104
S-1-2	Upstream	3.96	4.28	4.04	3.33	2.64	2.07	1.60	1.23	102
	Downstream	3.94	4.27	3.90	3.32	2.64	2.07	1.60	1.21	101
M-1-2	Upstream	4.08	4.63	4.38	3.63	2.91	2.30	1.78	1.35	108
	Downstream	4.32	4.74	4.27	3.67	2.93	2.31	1.79	1.34	101
L-1-2	Upstream	3.80	4.35	4.14	3.42	2.74	2.18	1.72	1.33	109
	Downstream	4.08	4.39	3.91	3.27	2.65	2.13	1.68	1.31	104
S-2-1	Upstream	4.62	4.96	4.49	3.69	2.91	2.27	1.76	1.33	97
	Downstream	4.42	4.74	4.26	3.59	2.86	2.25	1.75	1.30	104
M-2-1	Upstream	4.21	4.72	4.50	3.78	3.05	2.43	1.90	1.47	107
	Downstream	4.46	4.85	4.32	3.67	2.98	2.40	1.90	1.46	103
L-2-1	Upstream	4.10	4.59	4.31	3.67	3.01	2.46	1.97	1.54	105
	Downstream	4.28	4.53	4.13	3.56	2.96	2.43	1.95	1.51	104
S-2-2	Upstream	3.76	4.16	3.86	3.17	2.53	1.98	1.52	1.17	103
	Downstream	3.80	4.13	3.73	3.17	2.51	1.98	1.54	1.20	102
M-2-2	Upstream	3.58	4.09	3.93	3.20	2.53	1.97	1.52	1.15	110
	Downstream	3.84	4.07	3.57	2.96	2.36	1.86	1.46	1.10	108
L-2-2	Upstream	3.69	4.23	4.00	3.25	2.56	2.01	1.55	1.15	108
	Downstream	3.95	4.18	3.70	3.09	2.46	1.93	1.50	1.15	107

Section I.D.: 3-US287-1

Date: 7/18/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	3.71	4.09	3.80	3.18	2.56	2.05	1.65	1.35	102%
	Downstream	3.72	4.09	3.72	3.16	2.59	2.07	1.62	1.23	100%
M-1-1	Upstream	3.46	3.88	3.59	3.01	2.44	1.94	1.55	1.27	104%
	Downstream	3.58	3.97	3.62	3.07	2.51	1.98	1.62	1.35	99%
L-1-1	Upstream	4.07	4.43	4.11	3.53	2.86	2.30	1.75	1.36	101%
	Downstream	4.08	4.47	4.14	3.52	2.86	2.27	1.78	1.41	99%
M-1-2	Upstream	4.06	4.46	4.14	3.59	2.93	2.35	1.88	1.41	102%
	Downstream	4.14	4.53	4.14	3.59	2.97	2.38	1.85	1.12	100%
L-1-2	Upstream	3.90	4.34	4.03	3.43	2.84	2.31	1.88	1.61	103%
	Downstream	4.01	4.47	4.04	3.47	2.88	2.36	1.91	1.44	99%
S-1-2	Upstream	4.01	4.48	4.17	3.53	2.82	2.24	1.81	1.39	104%
	Downstream	4.09	4.42	3.99	3.44	2.81	2.23	1.78	1.33	102%
M-2-1	Upstream	4.26	4.63	4.35	3.79	3.16	2.56	2.07	1.72	102%
	Downstream	4.30	4.65	4.33	3.73	3.14	2.55	2.13	1.74	99%
L-2-1	Upstream	4.36	4.64	4.39	3.79	3.14	2.60	2.14	1.75	101%
	Downstream	4.34	4.72	4.35	3.77	3.19	2.67	2.17	1.67	100%
S-2-1	Upstream	4.45	4.81	4.46	3.79	3.14	2.53	2.07	1.71	100%
	Downstream	4.40	4.74	4.40	3.79	3.11	2.49	1.98	1.57	100%
L-2-2	Upstream	3.70	4.15	3.84	3.19	2.57	2.02	1.58	1.30	104%
	Downstream	3.82	4.25	3.77	3.16	2.58	2.06	1.57	1.18	101%
M-2-2	Upstream	3.76	4.17	3.85	3.24	2.59	2.04	1.62	1.29	102%
	Downstream	3.81	4.19	3.73	3.17	2.57	2.04	1.65	1.34	102%
S-2-2	Upstream	3.83	4.25	3.91	3.29	2.68	2.11	1.69	1.30	102%
	Downstream	3.91	4.29	3.88	3.28	2.66	2.12	1.71	1.44	101%

Section I.D.: 3-US287-2

Date: 2/27/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	1.25	1.39	1.26	1.12	1.02	0.90	0.86	0.72	101
	Downstream	1.22	1.32	1.21	1.16	1.02	0.88	0.77	0.82	101
M-1-1	Upstream	1.25	1.30	1.24	1.13	1.00	0.90	0.74	0.72	99
	Downstream	1.21	1.24	1.21	1.10	1.01	0.89	0.63	0.73	100
L-1-1	Upstream	1.24	1.37	1.34	1.18	1.06	0.96	0.94	0.83	108
	Downstream	1.25	1.34	1.36	1.20	1.09	1.02	0.90	0.85	92
S-1-2	Upstream	1.22	1.27	1.23	1.12	1.02	0.92	0.84	0.74	101
	Downstream	1.21	1.28	1.22	1.11	0.98	0.91	0.99	0.76	99
M-1-2	Upstream	1.22	1.36	1.29	1.17	1.01	0.89	0.76	0.73	106
	Downstream	1.27	1.43	1.25	1.13	0.98	0.89	0.60	0.71	101
L-1-2	Upstream	1.31	1.41	1.34	1.18	1.07	1.00	0.85	0.83	102
	Downstream	1.29	1.39	1.26	1.16	1.07	1.00	0.88	0.83	102
S-2-1	Upstream	1.21	1.26	1.21	1.10	0.97	0.89	0.74	0.73	100
	Downstream	1.18	1.21	1.17	1.09	0.97	0.88	0.78	0.72	101
M-2-1	Upstream	1.11	1.16	1.13	1.03	0.93	0.85	0.76	0.66	102
	Downstream	1.21	1.17	1.20	1.09	0.99	0.91	0.82	0.73	101
L-2-1	Upstream	1.13	1.26	1.11	1.02	0.93	0.85	0.78	0.71	98
	Downstream	1.06	1.13	1.11	1.02	0.94	0.83	0.63	0.77	96
S-2-2	Upstream	1.24	1.23	1.23	1.11	1.00	0.92	0.75	0.67	98
	Downstream	1.19	1.22	1.21	1.11	1.00	0.91	0.85	0.74	98
M-2-2	Upstream	1.20	1.23	1.24	1.04	0.93	0.85	0.91	0.68	103
	Downstream	1.06	1.16	1.09	0.98	0.88	0.77	0.68	0.62	97
L-2-2	Upstream	1.20	1.29	1.19	1.08	0.97	0.87	0.80	0.72	99
	Downstream	1.19	1.37	1.21	1.08	0.98	0.87	0.76	0.72	98

Section I.D.: 3-US287-2

Date: 8/29/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	1.64	1.81	1.66	1.46	1.29	1.13	1.01	0.87	101
	Downstream	1.62	1.90	1.61	1.44	1.26	1.13	0.99	0.87	101
M-1-1	Upstream	1.57	1.87	1.59	1.42	1.25	1.13	1.05	0.89	102
	Downstream	1.54	1.75	1.56	1.40	1.24	1.10	1.02	0.84	99
L-1-1	Upstream	1.48	1.76	1.58	1.40	1.28	1.10	1.05	0.86	107
	Downstream	1.52	1.81	1.53	1.41	1.26	1.14	1.04	0.97	99
S-1-2	Upstream	1.59	1.79	1.59	1.41	1.23	1.10	0.97	0.86	101
	Downstream	1.57	1.75	1.60	1.42	1.26	1.11	1.01	0.89	98
M-1-2	Upstream	1.41	1.65	1.41	1.27	1.12	1.01	0.91	0.79	100
	Downstream	1.39	1.63	1.40	1.24	1.11	1.00	0.91	0.79	99
L-1-2	Upstream	1.56	1.78	1.58	1.43	1.29	1.17	1.08	0.97	101
	Downstream	1.56	1.92	1.60	1.45	1.33	1.18	1.12	0.97	97
S-2-1	Upstream	1.43	1.62	1.46	1.30	1.15	1.02	0.92	0.78	102
	Downstream	1.46	1.67	1.49	1.32	1.19	1.05	0.96	0.85	98
M-2-1	Upstream	1.52	1.67	1.54	1.37	1.23	1.10	0.99	0.87	101
	Downstream	1.50	1.66	1.52	1.38	1.23	1.11	1.01	0.86	99
L-2-1	Upstream	1.35	1.55	1.39	1.23	1.11	1.01	0.92	0.83	103
	Downstream	1.34	1.55	1.38	1.24	1.12	1.00	0.93	0.79	97
S-2-2	Upstream	1.45	1.66	1.47	1.32	1.15	1.05	0.95	0.83	101
	Downstream	1.62	1.88	1.64	1.49	1.33	1.20	1.11	1.02	99
M-2-2	Upstream	1.29	1.55	1.31	1.17	1.06	0.92	0.81	0.69	101
	Downstream	1.30	1.56	1.34	1.21	1.05	0.93	0.80	0.68	97
L-2-2	Upstream	1.44	1.64	1.47	1.31	1.16	1.02	0.91	0.81	103
	Downstream	1.46	1.76	1.49	1.31	1.14	1.04	0.94	0.81	98

Section I.D.: 3-US287-2

Date: 2/28/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	1.31	1.38	1.30	1.19	1.08	0.96	0.85	0.76	99
	Downstream	1.29	1.44	1.32	1.21	1.07	0.96	0.86	0.77	98
M-1-1	Upstream	1.35	1.47	1.35	1.21	1.10	0.98	0.87	0.77	100
	Downstream	1.32	1.46	1.33	1.22	1.08	0.98	0.87	0.78	99
L-1-1	Upstream	1.40	1.57	1.42	1.30	1.16	1.04	0.94	0.86	102
	Downstream	1.42	1.59	1.40	1.32	1.18	1.06	0.95	0.83	101
S-1-2	Upstream	1.32	1.49	1.34	1.23	1.09	0.96	0.85	0.73	102
	Downstream	1.31	1.48	1.31	1.20	1.06	0.92	0.80	0.67	100
M-1-2	Upstream	1.45	1.60	1.47	1.35	1.21	1.11	1.00	0.90	101
	Downstream	1.46	1.60	1.46	1.35	1.22	1.11	1.02	0.91	100
L-1-2	Upstream	1.45	1.62	1.46	1.32	1.19	1.07	0.95	0.85	101
	Downstream	1.48	1.64	1.44	1.36	1.20	1.05	0.94	0.76	103
S-2-1	Upstream	1.32	1.45	1.33	1.22	1.10	0.98	0.89	0.78	101
	Downstream	1.30	1.44	1.31	1.19	1.08	0.97	0.87	0.77	99
M-2-1	Upstream	1.37	1.50	1.35	1.26	1.14	1.04	0.95	0.83	99
	Downstream	1.31	1.42	1.31	1.21	1.10	1.00	0.90	0.80	100
L-2-1	Upstream	1.26	1.39	1.27	1.15	1.03	0.94	0.85	0.77	101
	Downstream	1.27	1.39	1.28	1.16	1.05	0.95	0.86	0.76	99
S-2-2	Upstream	1.36	1.51	1.38	1.24	1.13	1.02	0.92	0.83	101
	Downstream	1.36	1.50	1.37	1.26	1.14	1.02	0.94	0.83	99
M-2-2	Upstream	1.32	1.48	1.33	1.20	1.06	0.93	0.84	0.72	101
	Downstream	1.30	1.46	1.31	1.19	1.06	0.94	0.83	0.72	99
L-2-2	Upstream	1.29	1.41	1.31	1.19	1.07	0.94	0.86	0.77	102
	Downstream	1.33	1.45	1.34	1.22	1.10	0.98	0.89	0.80	99

Section I.D.: 3-US287-2

Date: 7/18/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	1.51	1.71	1.53	1.32	1.17	1.01	0.90	0.73	101%
	Downstream	1.51	1.70	1.51	1.33	1.17	1.04	0.92	0.84	100%
M-1-1	Upstream	1.44	1.60	1.46	1.30	1.16	1.01	0.92	0.87	101%
	Downstream	1.41	1.61	1.45	1.28	1.15	1.02	0.94	0.90	98%
L-1-1	Upstream	1.33	1.45	1.35	1.24	1.08	0.97	0.87	0.74	101%
	Downstream	1.44	1.59	1.47	1.35	1.19	1.04	0.99	0.84	98%
M-1-2	Upstream	1.29	1.43	1.27	1.09	0.98	0.85	0.77	0.68	99%
	Downstream	1.35	1.50	1.36	1.22	1.09	0.95	0.86	0.76	99%
L-1-2	Upstream	1.55	1.67	1.56	1.41	1.29	1.17	1.04	0.94	101%
	Downstream	1.53	1.67	1.54	1.43	1.25	1.12	1.04	0.99	99%
S-1-2	Upstream	1.59	1.77	1.59	1.38	1.27	1.10	1.02	0.95	100%
	Downstream	1.69	1.87	1.68	1.51	1.36	1.23	1.09	0.92	101%
M-2-1	Upstream	1.52	1.68	1.58	1.38	1.26	1.05	0.97	0.87	104%
	Downstream	1.49	1.66	1.51	1.34	1.19	1.05	0.97	0.83	99%
M-2-2	Upstream	1.34	1.42	1.32	1.17	1.06	0.91	0.83	0.74	99%
	Downstream	1.33	1.47	1.34	1.20	1.09	0.93	0.82	0.70	99%
S-2-1	Upstream	1.41	1.56	1.45	1.26	1.11	0.98	0.89	0.79	103%
	Downstream	1.42	1.58	1.44	1.27	1.16	1.01	0.92	0.83	99%
S-2-2	Upstream	1.45	1.62	1.48	1.28	1.20	1.02	0.96	0.92	102%
	Downstream	1.43	1.60	1.47	1.28	1.15	1.04	0.95	0.90	98%
L-2-1	Upstream	1.29	1.44	1.32	1.20	1.08	0.91	0.86	0.79	102%
	Downstream	1.31	1.43	1.33	1.17	1.07	0.96	0.90	0.85	99%
L-2-2	Upstream	1.42	1.54	1.42	1.27	1.13	0.97	0.87	0.71	100%
	Downstream	1.40	1.57	1.44	1.28	1.13	0.99	0.91	0.82	97%

Section I.D.: 4-I40-1

Date: 3/15/2023

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S-1-1	Upstream	3.09	3.05	2.92	2.53	2.20	1.79	1.64	1.28	95
	Downstream	3.04	2.88	2.73	2.41	2.23	1.88	1.53	1.49	111
M-1-1	Upstream	2.11	2.25	2.04	1.71	1.44	1.18	0.92	0.87	97
	Downstream	2.17	2.36	1.95	1.73	1.48	1.34	1.02	0.76	111
L-1-1	Upstream	2.80	2.62	2.88	2.49	2.28	1.99	1.57	1.39	103
	Downstream	3.05	2.91	2.95	2.54	2.20	1.89	1.57	1.32	104
S-1-2	Upstream	3.99	4.53	4.26	3.57	3.14	1.79	1.47	1.26	107
	Downstream	4.61	6.18	6.81	6.73	2.26	1.88	1.53	1.27	68
M-1-2	Upstream	3.23	3.33	3.36	2.89	2.52	1.87	1.61	1.45	104
	Downstream	3.60	3.67	3.23	2.93	2.60	2.11	1.81	1.43	111
L-1-2	Upstream	2.60	2.69	2.84	2.53	1.98	1.99	1.52	1.45	109
	Downstream	2.75	2.93	2.57	2.14	1.79	1.46	1.18	0.92	107
S-2-1	Upstream	2.97	3.42	2.97	2.51	2.29	1.86	1.51	1.10	100
	Downstream	3.04	3.35	3.04	2.68	2.22	1.88	1.48	1.44	100
M-2-1	Upstream	4.14	4.29	4.18	3.68	3.18	2.67	2.03	1.62	101
	Downstream	4.36	4.39	3.91	3.35	2.65	2.23	1.69	1.34	112
L-2-1	Upstream	2.68	2.91	2.84	2.44	2.07	1.84	1.56	1.44	106
	Downstream	2.93	2.94	2.65	2.30	1.87	1.79	1.46	1.28	110
S-2-2	Upstream	3.17	3.22	3.14	2.74	2.37	2.02	1.58	1.34	99
	Downstream	3.27	3.41	3.16	2.88	2.53	2.00	1.63	1.31	103
M-2-2	Upstream	3.14	3.31	3.18	2.68	2.35	1.95	1.48	1.20	101
	Downstream	3.26	3.18	3.00	2.59	2.22	1.91	1.59	1.32	109
L-2-2	Upstream	3.33	3.60	3.46	3.05	2.65	2.30	1.88	1.55	104
	Downstream	3.49	3.75	3.34	2.96	2.62	2.19	1.80	1.48	105

Section I.D.: 4-I40-1

Date: 2/20/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	3.19	3.27	3.03	2.56	2.26	1.83	1.58	1.32	105
	Downstream	2.99	2.84	2.75	2.39	2.05	1.79	1.50	1.28	92
M-1-1	Upstream	2.31	2.65	2.45	2.09	1.74	1.48	1.20	1.07	94
	Downstream	2.53	2.63	2.40	2.09	1.78	1.50	1.16	1.03	95
L-1-1	Upstream	2.87	3.16	3.04	2.59	2.20	1.86	1.53	1.27	95
	Downstream	3.10	3.23	2.97	2.56	2.22	1.87	1.59	1.30	96
S-1-2	Upstream	4.18	4.52	4.25	3.34	2.53	1.85	1.53	1.29	98
	Downstream	4.43	6.18	5.65	4.53	2.10	1.76	1.47	1.18	128
M-1-2	Upstream	3.37	3.81	3.53	2.94	2.52	2.15	1.65	1.40	96
	Downstream	3.54	3.72	3.28	2.85	2.42	2.06	1.69	1.36	93
L-1-2	Upstream	3.08	3.14	3.18	2.67	2.30	1.95	1.61	1.36	97
	Downstream	2.99	3.07	2.73	2.34	1.99	1.71	1.37	1.17	91
S-2-1	Upstream	2.97	3.05	3.07	2.64	2.29	1.97	1.64	1.39	97
	Downstream	3.12	3.13	2.97	2.62	2.22	1.84	1.52	1.25	95
M-2-1	Upstream	3.72	3.79	3.88	3.31	2.80	2.35	1.86	1.51	96
	Downstream	3.92	3.99	3.60	3.10	2.62	2.25	1.77	1.45	92
L-2-1	Upstream	2.70	2.96	2.78	2.36	2.03	1.73	1.43	1.19	97
	Downstream	2.91	2.79	2.64	2.26	1.89	1.72	1.41	1.28	91
S-2-2	Upstream	3.10	3.51	3.32	2.82	2.39	2.04	1.60	1.30	93
	Downstream	3.21	3.40	3.22	2.84	2.39	2.00	1.53	1.31	100
M-2-2	Upstream	3.20	3.53	3.36	2.80	2.31	1.93	1.56	1.28	95
	Downstream	3.43	3.46	3.15	2.69	2.23	1.94	1.56	1.33	92
L-2-2	Upstream	3.20	3.49	3.35	2.84	2.42	2.00	1.51	1.35	95
	Downstream	3.45	3.40	3.14	2.75	2.33	1.98	1.59	1.32	91

Section I.D.: 4-I40-1

Date: 8/13/2024

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S11	Upstream	2.66	2.92	2.68	2.35	2.07	1.86	1.57	1.36	99%
	Downstream	2.64	2.89	2.62	2.29	1.99	1.76	1.46	1.26	99%
M11	Upstream	2.04	2.14	2.06	1.75	1.48	1.30	1.07	0.90	99%
	Downstream	2.03	2.23	2.00	1.71	1.47	1.27	1.06	0.90	99%
L11	Upstream	2.60	2.89	2.68	2.35	2.11	1.87	1.58	1.30	97%
	Downstream	2.68	2.80	2.77	2.39	2.15	1.92	1.61	1.34	103%
S12	Upstream	3.53	3.72	3.52	2.84	2.29	1.90	1.57	1.30	100%
	Downstream	3.48	4.30	3.80	2.75	2.16	1.87	1.55	1.29	109%
M12	Upstream	3.02	4.11	3.04	2.71	2.43	2.12	1.80	1.46	99%
	Downstream	3.04	3.80	3.02	2.70	2.30	1.96	1.60	1.29	100%
L12	Upstream	2.57	3.45	2.65	2.29	2.02	1.83	1.52	1.30	97%
	Downstream	2.60	2.95	2.61	2.31	2.04	1.81	1.51	1.29	101%
S21	Upstream	3.00	3.46	3.08	2.73	2.38	2.07	1.70	1.41	97%
	Downstream	3.13	3.32	3.10	2.76	2.38	2.06	1.71	1.39	99%
M21	Upstream	3.45	3.93	3.41	3.02	2.64	2.34	1.93	1.60	101%
	Downstream	3.33	3.35	3.24	2.86	2.54	2.21	1.85	1.50	97%
L21	Upstream	2.58	2.85	2.59	2.27	2.00	1.77	1.50	1.28	99%
	Downstream	2.51	2.96	2.51	2.23	1.98	1.74	1.50	1.28	100%
S22	Upstream	3.13	3.34	3.11	2.75	2.37	2.04	1.67	1.39	100%
	Downstream	3.14	3.26	3.15	2.75	2.34	2.06	1.65	1.34	100%
M22	Upstream	2.68	2.84	2.74	2.37	2.07	1.83	1.51	1.26	98%
	Downstream	2.72	2.98	2.73	2.41	2.14	1.86	1.54	1.27	100%
L22	Upstream	2.98	3.35	2.97	2.62	2.31	2.08	1.71	1.42	100%
	Downstream	2.91	3.10	2.97	2.65	2.35	2.06	1.70	1.43	102%

Section I.D.: 5-I27-1

Date: 3/7/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	2.36	2.61	2.37	2.10	1.53	1.47	1.19	0.93	101
	Downstream	2.71	2.65	2.54	2.16	1.71	1.44	1.16	0.98	107
M-1-1	Upstream	2.96	3.13	2.92	2.51	2.10	1.84	1.42	1.28	99
	Downstream	2.73	2.33	2.26	2.17	0.03	1.49	1.15	0.62	121
L-1-1	Upstream	2.23	2.13	2.20	1.95	1.61	1.42	1.08	0.91	99
	Downstream	1.36	2.52	2.13	1.95	0.97	1.14	1.16	0.79	64
S-1-2	Upstream	1.98	2.26	2.08	1.85	0.00	1.30	1.01	0.79	105
	Downstream	1.84	2.41	2.02	1.75	1.16	1.33	1.02	0.84	91
M-1-2	Upstream	2.19	2.31	2.13	1.92	1.42	1.36	1.04	0.94	97
	Downstream	2.22	2.29	2.19	1.89	1.53	1.28	0.95	0.90	101
L-1-2	Upstream	2.85	2.72	2.68	2.23	1.54	1.49	1.09	0.97	94
	Downstream	2.13	2.97	2.65	2.29	1.98	1.63	1.19	1.04	80
S-2-1	Upstream	2.54	2.47	2.38	2.06	1.43	1.42	1.18	0.88	94
	Downstream	2.41	2.30	2.34	2.08	1.32	1.43	1.19	0.95	103
M-2-1	Upstream	2.37	2.37	2.40	2.02	1.37	1.43	1.22	1.12	101
	Downstream	2.55	2.48	2.37	2.08	1.56	1.40	1.11	0.90	108
L-2-1	Upstream	3.45	3.60	3.46	2.87	1.95	1.85	1.40	1.01	100
	Downstream	3.63	3.73	3.32	2.79	2.17	1.56	0.93	1.09	109
S-2-2	Upstream	2.61	2.83	2.72	2.36	1.81	1.43	1.02	0.88	104
	Downstream	2.85	2.99	2.83	2.59	1.61	1.63	1.16	0.88	100
M-2-2	Upstream	3.44	3.63	3.63	3.06	2.08	1.82	1.46	1.15	106
	Downstream	3.46	3.63	3.32	2.69	2.16	1.72	1.21	1.00	104
L-2-2	Upstream	2.30	2.38	2.37	1.99	1.40	1.43	0.97	0.97	103
	Downstream	2.45	2.50	2.43	2.00	1.68	1.43	1.12	0.91	101

Section I.D.: 5-I27-1

Date: 2/15/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S-1-1	Upstream	2.65	2.73	2.57	2.09	1.75	1.49	1.18	0.99	97
	Downstream	2.65	2.81	2.57	2.13	1.79	1.52	1.22	0.99	103
M-1-1	Upstream	3.44	3.61	3.39	2.82	2.33	1.93	1.56	1.25	98
	Downstream	3.49	3.53	3.20	2.70	2.29	1.90	1.55	1.24	109
L-1-1	Upstream	2.85	3.18	2.96	2.34	1.90	1.53	1.14	0.92	104
	Downstream	3.03	3.39	2.85	2.36	1.92	1.53	1.16	0.92	106
S-1-2	Upstream	2.31	2.43	2.23	1.82	1.49	1.25	1.03	0.85	97
	Downstream	2.29	2.42	2.13	1.77	1.48	1.24	1.03	0.84	108
M-1-2	Upstream	2.21	2.49	2.17	1.82	1.54	1.31	1.05	0.88	98
	Downstream	2.27	2.48	2.24	1.90	1.60	1.36	1.08	0.91	102
L-1-2	Upstream	2.96	3.25	2.99	2.43	1.95	1.55	1.20	0.93	101
	Downstream	3.08	3.29	2.86	2.32	1.87	1.50	1.19	0.95	108
S-2-1	Upstream	2.31	2.49	2.26	1.91	1.62	1.38	1.14	0.92	98
	Downstream	2.32	2.52	2.29	1.94	1.66	1.41	1.12	0.93	101
M-2-1	Upstream	2.76	3.00	2.80	2.40	2.05	1.70	1.33	1.08	101
	Downstream	2.92	3.00	2.76	2.35	1.96	1.62	1.26	1.01	106
L-2-1	Upstream	3.51	3.88	3.60	2.89	2.36	1.83	1.34	0.98	102
	Downstream	3.67	3.78	3.32	2.73	2.20	1.69	1.24	0.97	111
S-2-2	Upstream	2.72	3.08	2.87	2.40	2.00	1.60	1.23	0.92	106
	Downstream	2.96	3.25	2.93	2.48	2.00	1.53	1.13	0.85	101
M-2-2	Upstream	3.49	3.77	3.47	2.85	2.29	1.84	1.40	1.08	99
	Downstream	3.58	3.71	3.34	2.78	2.28	1.83	1.38	1.05	107
L-2-2	Upstream	2.34	2.57	2.33	1.96	1.65	1.37	1.09	0.87	100
	Downstream	2.37	2.60	2.29	1.94	1.62	1.35	1.08	0.87	103

Section I.D.: 5-I27-1

Date: 8/12/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
's11	Upstream	2.60	3.06	2.58	2.19	1.85	1.59	1.27	1.04	100%
	Downstream	2.56	2.99	2.51	2.12	1.85	1.60	1.23	1.04	102%
'm11	Upstream	2.89	3.01	2.95	2.55	2.17	1.88	1.53	1.25	102%
	Downstream	2.89	3.39	2.95	2.56	2.22	1.90	1.56	1.28	98%
'l11	Upstream	2.33	2.63	2.33	1.91	1.60	1.36	1.08	0.88	100%
	Downstream	2.25	2.56	2.28	1.90	1.59	1.35	1.09	0.88	99%
's12	Upstream	2.19	2.30	2.24	1.89	1.58	1.35	1.09	0.88	102%
	Downstream	2.23	2.78	2.19	1.84	1.54	1.35	1.07	0.85	102%
'm12	Upstream	2.39	2.89	2.43	2.03	1.72	1.44	1.16	0.96	102%
	Downstream	2.39	2.93	2.43	1.99	1.69	1.42	1.19	0.92	98%
'l12	Upstream	2.55	2.94	2.61	2.19	1.81	1.54	1.22	0.99	103%
	Downstream	2.59	3.45	2.60	2.17	1.81	1.52	1.23	0.99	100%
'S21	Upstream	2.47	2.75	2.48	2.04	1.72	1.45	1.15	0.96	101%
	Downstream	2.53	2.94	2.51	2.10	1.73	1.44	1.14	0.95	101%
M21	Upstream	2.27	2.47	2.29	1.91	1.59	1.35	1.07	0.85	101%
	Downstream	2.29	2.63	2.28	1.91	1.60	1.35	1.05	0.89	101%
'L21	Upstream	2.36	2.80	2.40	1.99	1.66	1.41	1.11	0.90	102%
	Downstream	2.33	2.67	2.39	1.97	1.67	1.42	1.12	0.90	97%
'S22	Upstream	2.18	2.38	2.27	1.88	1.57	1.31	1.03	0.85	104%
	Downstream	2.31	2.58	2.32	1.94	1.62	1.33	1.05	0.84	99%
'M22	Upstream	2.34	2.62	2.38	1.98	1.65	1.42	1.12	0.92	102%
	Downstream	2.39	2.83	2.37	1.98	1.67	1.43	1.12	0.93	101%
'L22	Upstream	2.39	2.50	2.45	2.01	1.65	1.33	1.05	0.85	103%
	Downstream	2.47	2.48	2.44	2.06	1.71	1.42	1.14	0.92	101%

Section I.D.: 3-US287-2

Date: 2/26/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream	2.54	2.65	2.45	2.10	1.75	1.44	1.25	0.99	104
	Downstream	2.43	2.56	2.33	2.01	1.69	1.39	1.18	0.95	96
M11	Upstream	2.16	2.28	2.12	1.82	1.53	1.27	1.09	0.95	102
	Downstream	2.08	2.29	2.04	1.78	1.49	1.26	1.05	0.88	98
L11	Upstream	2.75	2.87	2.74	2.38	2.02	1.68	1.39	1.08	100
	Downstream	2.73	2.85	2.66	2.33	1.96	1.60	1.29	0.99	97
S12	Upstream	2.08	2.24	2.05	1.81	1.55	1.29	1.11	0.95	101
	Downstream	2.13	2.30	2.14	1.88	1.58	1.32	1.14	0.98	100
M12	Upstream	2.11	2.28	2.16	1.93	1.65	1.40	1.21	0.98	98
	Downstream	2.14	2.37	2.20	1.94	1.69	1.43	1.21	0.99	102
L12	Upstream									
	Downstream									
S21	Upstream	2.33	2.53	2.35	2.09	1.81	1.55	1.33	1.13	99
	Downstream	2.38	2.54	2.41	2.13	1.84	1.59	1.35	1.14	101
M21	Upstream	2.26	2.48	2.25	1.96	1.68	1.42	1.20	0.99	101
	Downstream	2.27	2.45	2.24	1.98	1.68	1.41	1.17	0.98	98
L21	Upstream									
	Downstream									
S22	Upstream	2.81	3.09	2.90	2.54	2.19	1.85	1.53	1.21	97
	Downstream	2.90	3.14	2.95	2.57	2.20	1.84	1.50	1.15	102
M22	Upstream	2.39	2.56	2.44	2.16	1.86	1.55	1.31	1.08	98
	Downstream	2.47	2.69	2.48	2.20	1.88	1.57	1.29	1.06	100
L22	Upstream	2.16	2.26	2.08	1.78	1.47	1.22	1.04	0.86	104
	Downstream	2.11	2.23	2.04	1.76	1.48	1.25	1.02	0.89	97

Section I.D.: 12-US290-1

Date: 8/20/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream	2.74	2.98	2.71	2.39	2.04	1.70	1.43	1.15	99
	Downstream	2.69	2.87	2.63	2.35	1.98	1.68	1.40	1.16	103
M11	Upstream	2.33	2.56	2.28	2.00	1.66	1.39	1.16	1.01	98
	Downstream	2.24	2.40	2.18	1.91	1.59	1.37	1.14	0.99	103
L11	Upstream	2.67	2.86	2.64	2.31	1.94	1.61	1.35	1.15	99
	Downstream	2.61	2.73	2.53	2.23	1.89	1.57	1.31	1.11	103
S12	Upstream	2.18	2.44	2.24	1.96	1.71	1.47	1.24	1.06	103
	Downstream	2.24	2.45	2.26	2.05	1.73	1.46	1.29	1.05	99
M12	Upstream	2.27	2.45	2.33	2.09	1.80	1.53	1.34	1.12	103
	Downstream	2.31	2.53	2.35	2.10	1.83	1.58	1.36	1.12	98
L12	Upstream									
	Downstream									
S21	Upstream	2.56	2.76	2.60	2.35	2.04	1.80	1.54	1.32	101
	Downstream	2.54	2.75	2.63	2.37	2.05	1.74	1.52	1.28	97
M21	Upstream	2.62	2.87	2.65	2.33	1.98	1.68	1.42	1.17	101
	Downstream	2.70	2.88	2.73	2.40	2.07	1.76	1.42	1.20	99
L21	Upstream									
	Downstream									
S22	Upstream	3.68	3.86	3.63	3.21	2.70	2.25	1.83	1.48	99
	Downstream	3.62	3.78	3.54	3.11	2.59	2.14	1.83	1.40	102
M22	Upstream	3.18	3.43	3.17	2.81	2.41	2.06	1.71	1.37	99
	Downstream	3.20	3.41	3.18	2.81	2.41	2.02	1.65	1.35	101
L22	Upstream	2.47	2.77	2.53	2.21	1.89	1.58	1.44	1.12	103
	Downstream	2.61	2.75	2.62	2.34	1.98	1.66	1.37	1.14	100

Section I.D.: 24-I10-1

Date: 5/27/2023

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S-1-1	Upstream	1.20	1.32	1.18	1.04	0.92	0.81	0.70	0.62	101
	Downstream	1.21	1.34	1.22	1.08	0.95	0.82	0.74	0.66	101
M-1-1	Upstream	1.20	1.27	1.20	1.10	0.96	0.83	0.74	0.68	100
	Downstream	1.20	1.26	1.20	1.07	0.95	0.81	0.73	0.67	100
L-1-1	Upstream	1.10	1.21	1.10	0.99	0.88	0.80	0.69	0.59	100
	Downstream	1.14	1.45	1.13	1.05	0.93	0.79	0.72	0.66	99
S-1-2	Upstream	1.10	1.20	1.14	1.05	0.93	0.81	0.72	0.61	97
	Downstream	1.17	1.43	1.20	1.11	0.97	0.84	0.77	0.73	103
M-1-2	Upstream	1.13	1.22	1.11	1.02	0.93	0.79	0.72	0.64	102
	Downstream	1.12	1.15	1.07	0.97	0.87	0.74	0.65	0.58	95
L-1-2	Upstream	1.17	1.38	1.17	1.07	0.94	0.80	0.72	0.65	100
	Downstream	1.18	1.34	1.24	1.11	1.00	0.88	0.79	0.71	105
S-2-1	Upstream	1.12	1.21	1.13	1.03	0.82	0.75	0.70	0.61	99
	Downstream	1.13	1.24	1.15	1.04	0.91	0.79	0.70	0.61	102
M-2-1	Upstream	1.14	1.18	1.14	1.01	0.89	0.79	0.72	0.62	100
	Downstream	1.10	1.23	1.14	1.01	0.91	0.76	0.70	0.63	103
L-2-1	Upstream	1.18	1.32	1.17	1.04	0.92	0.80	0.71	0.63	101
	Downstream	1.15	1.17	1.16	1.05	0.92	0.79	0.71	0.65	101
S-2-2	Upstream	1.14	1.29	1.12	1.02	0.89	0.76	0.67	0.58	102
	Downstream	1.13	1.12	1.15	1.04	0.91	0.79	0.72	0.62	102
M-2-2	Upstream	1.09	1.16	1.10	0.99	0.88	0.78	0.71	0.62	98
	Downstream	1.07	1.21	1.09	0.98	0.86	0.75	0.69	0.61	102
L-2-2	Upstream	1.10	1.26	1.11	1.00	0.91	0.81	0.73	0.62	99
	Downstream	1.11	1.26	1.13	1.03	0.91	0.81	0.72	0.64	102

Section I.D.: 24-I10-2

Date: 2/22/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream									
	Downstream									
M11	Upstream	1.78	1.98	1.98	1.78	1.59	1.39	1.26	1.12	111
	Downstream	1.88	1.92	1.79	1.55	1.36	1.13	0.99	0.86	105
L11	Upstream	2.08	2.04	2.09	1.81	1.59	1.33	1.16	1.00	101
	Downstream	1.66	1.81	1.53	1.32	1.11	0.89	0.74	0.61	108
S12	Upstream									
	Downstream									
M12	Upstream	1.78	1.93	1.85	1.63	1.40	1.18	1.02	0.88	104
	Downstream	1.84	1.76	1.76	1.62	1.32	1.15	1.01	0.90	104
L12	Upstream	1.78	1.98	1.83	1.65	1.37	1.14	1.01	0.87	103
	Downstream	1.91	2.02	1.79	1.54	1.35	1.12	0.97	0.85	107
S21	Upstream									
	Downstream									
M21	Upstream	1.81	1.89	1.82	1.60	1.43	1.21	1.06	0.92	101
	Downstream	1.76	1.89	1.67	1.50	1.29	1.09	0.95	0.82	105
L21	Upstream	1.73	1.89	1.85	1.63	1.38	1.15	1.01	0.88	107
	Downstream	1.86	1.92	1.74	1.53	1.32	1.10	0.97	0.83	107
S22	Upstream									
	Downstream									
M22	Upstream	1.57	1.77	1.68	1.46	1.32	1.11	0.98	0.87	107
	Downstream	1.86	2.09	1.80	1.65	1.42	1.23	1.09	0.96	104
L22	Upstream	1.70	1.87	1.75	1.54	1.32	1.10	0.97	0.86	103
	Downstream	1.73	1.83	1.65	1.49	1.25	1.05	0.92	0.79	105

Section I.D.: 24-I10-2

Date: 7/15/2024

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S11	Upstream									
	Downstream									
M11	Upstream	1.54	1.75	1.58	1.48	1.28	1.11	0.97	0.86	102
	Downstream	1.59	1.82	1.59	1.44	1.27	1.12	1.00	0.85	100
L11	Upstream	1.47	1.52	1.50	1.36	1.19	1.03	0.93	0.78	102
	Downstream	1.43	1.50	1.44	1.32	1.14	1.00	0.93	0.76	99
S12	Upstream									
	Downstream									
M12	Upstream	1.61	1.81	1.60	1.45	1.28	1.09	1.02	0.81	99
	Downstream	1.47	1.56	1.49	1.33	1.16	0.98	0.90	0.78	98
L12	Upstream	1.46	1.56	1.50	1.35	1.18	1.02	0.92	0.76	103
	Downstream	1.45	1.64	1.47	1.32	1.15	0.97	0.89	0.74	99
S21	Upstream									
	Downstream									
L21	Upstream	1.47	1.61	1.51	1.38	1.22	1.03	0.94	0.78	102
	Downstream	1.48	1.59	1.50	1.38	1.20	1.03	0.94	0.78	99
M21	Upstream	1.58	1.80	1.59	1.47	1.27	1.11	1.00	0.83	101
	Downstream	1.59	1.80	1.59	1.44	1.27	1.09	1.00	0.83	100
S22	Upstream									
	Downstream									
M22	Upstream	1.47	1.63	1.50	1.36	1.18	1.01	0.92	0.76	102
	Downstream	1.52	1.76	1.54	1.36	1.20	1.01	0.92	0.76	98
L22	Upstream	1.66	2.04	1.72	1.53	1.33	1.12	0.99	0.85	104
	Downstream	1.72	1.94	1.73	1.59	1.35	1.16	1.04	0.88	99

Section I.D.: 24-I10-3

Date: 5/23/2023

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S-1-1	Upstream	1.78	1.91	1.78	1.54	1.30	1.03	0.88	0.73	100
	Downstream	1.76	1.92	1.75	1.50	1.27	1.03	0.84	0.68	100
M-1-1	Upstream	1.81	1.93	1.82	1.62	1.41	1.18	1.02	0.88	99
	Downstream	1.84	1.97	1.85	1.64	1.42	1.17	1.03	0.88	101
L-1-1	Upstream	1.46	1.57	1.42	1.24	1.07	0.90	0.79	0.66	103
	Downstream	1.48	1.61	1.51	1.33	1.17	0.98	0.87	0.74	102
S-1-2	Upstream	1.56	1.58	1.58	1.44	1.25	1.07	0.94	0.82	99
	Downstream	1.57	1.63	1.60	1.44	1.26	1.08	0.96	0.81	102
M-1-2	Upstream	1.52	1.64	1.55	1.37	1.17	1.00	0.85	0.75	98
	Downstream	1.52	1.62	1.53	1.36	1.17	0.98	0.85	0.72	101
L-1-2	Upstream	1.55	1.66	1.55	1.36	1.18	1.00	0.86	0.79	100
	Downstream	1.50	1.61	1.52	1.36	1.17	0.99	0.85	0.74	102
S-2-1	Upstream	1.54	1.62	1.54	1.38	1.21	1.06	0.94	0.83	100
	Downstream	1.50	1.42	1.52	1.38	1.21	1.06	0.93	0.85	101
M-2-1	Upstream	1.50	1.67	1.51	1.38	1.22	1.05	0.92	0.79	99
	Downstream	1.50	1.55	1.48	1.34	1.18	1.01	0.90	0.77	99
L-2-1	Upstream	1.48	1.36	1.50	1.36	1.19	1.03	0.91	0.80	98
	Downstream	1.50	1.69	1.51	1.37	1.21	1.04	0.91	0.81	101
S-2-2	Upstream	1.50	1.49	1.50	1.34	1.15	1.00	0.86	0.71	100
	Downstream	1.50	1.61	1.50	1.34	1.16	0.99	0.84	0.73	99
M-2-2	Upstream	1.61	1.53	1.60	1.45	1.27	1.09	0.96	0.81	101
	Downstream	1.57	1.62	1.57	1.43	1.28	1.11	0.98	0.88	101
L-2-2	Upstream	1.59	1.88	1.65	1.49	1.31	1.13	1.00	0.88	97
	Downstream	1.61	1.78	1.61	1.45	1.27	1.10	0.97	0.84	100

Section I.D.: 24-I10-3

Date: 2/22/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream	1.91	1.93	1.88	1.67	1.43	1.19	1.02	0.86	99
	Downstream	1.86	2.06	1.83	1.62	1.39	1.16	0.99	0.84	101
M11	Upstream	1.88	2.03	1.95	1.77	1.56	1.37	1.22	1.08	103
	Downstream	1.87	1.90	1.87	1.67	1.47	1.23	1.07	0.91	100
L11	Upstream	1.59	1.68	1.61	1.45	1.26	1.09	0.96	0.83	102
	Downstream	1.61	1.75	1.61	1.45	1.26	1.08	0.95	0.82	100
S12	Upstream	1.72	1.89	1.74	1.59	1.41	1.22	1.08	0.96	101
	Downstream	1.70	1.84	1.73	1.59	1.42	1.24	1.09	0.98	98
M12	Upstream	1.65	1.78	1.66	1.47	1.28	1.07	0.93	0.81	101
	Downstream	1.70	1.91	1.68	1.51	1.31	1.11	0.96	0.84	101
L12	Upstream	1.69	1.80	1.66	1.49	1.27	1.10	0.96	0.84	98
	Downstream	1.64	1.83	1.63	1.46	1.28	1.09	0.96	0.84	101
L13	Upstream	1.79	1.83	1.73	1.56	1.38	1.19	1.03	0.91	97
	Downstream	1.68	1.86	1.70	1.52	1.42	1.19	1.07	0.95	99
M21	Upstream	1.75	1.94	1.78	1.59	1.41	1.19	1.04	0.93	102
	Downstream	1.79	1.88	1.73	1.57	1.38	1.23	1.06	0.91	103
L21	Upstream	1.73	1.85	1.73	1.57	1.39	1.21	1.07	0.95	101
	Downstream	1.73	1.86	1.71	1.53	1.39	1.19	1.04	0.92	102
M22	Upstream	1.88	2.24	1.93	1.75	1.49	1.29	1.15	1.03	103
	Downstream	1.93	2.06	1.84	1.66	1.48	1.30	1.14	1.00	104
L22	Upstream	1.89	2.17	1.97	1.79	1.51	1.32	1.16	1.01	104
	Downstream	1.94	2.23	1.91	1.71	1.48	1.29	1.15	0.98	102
L23	Upstream	1.78	1.83	1.85	1.66	1.48	1.29	1.13	0.98	104
	Downstream	1.85	1.90	1.80	1.63	1.44	1.25	1.09	0.96	103

Section I.D.: 24-I10-3

Date: 7/16/2024

Cracks		**W8**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**LTE**
S11	Upstream	1.72	1.81	1.73	1.50	1.23	1.04	0.93	0.72	101
	Downstream	1.66	1.71	1.68	1.46	1.23	1.01	0.89	0.71	99
M11	Upstream	1.76	1.80	1.78	1.60	1.38	1.16	1.03	0.86	101
	Downstream	1.75	1.73	1.77	1.57	1.36	1.14	1.01	0.84	99
L11	Upstream	1.40	1.45	1.43	1.28	1.12	0.95	0.85	0.72	103
	Downstream	1.39	1.49	1.40	1.27	1.09	0.95	0.84	0.71	99
S12	Upstream	1.47	1.60	1.50	1.35	1.19	1.02	0.93	0.77	102
	Downstream	1.50	1.67	1.53	1.37	1.21	1.04	0.93	0.80	98
M12	Upstream	1.46	1.55	1.50	1.34	1.15	0.98	0.87	0.74	103
	Downstream	1.49	1.58	1.51	1.36	1.15	0.98	0.89	0.74	99
L12	Upstream	1.45	1.41	1.45	1.32	1.14	0.97	0.87	0.74	100
	Downstream	1.45	1.58	1.47	1.31	1.15	0.99	0.85	0.74	99
L13	Upstream	1.49	1.60	1.57	1.42	1.23	1.09	1.05	0.80	105
	Downstream	1.53	1.61	1.57	1.40	1.24	1.07	0.96	0.80	98
M21	Upstream	1.49	1.40	1.49	1.35	1.17	1.01	0.91	0.75	101
	Downstream	1.49	1.53	1.50	1.36	1.20	1.04	0.92	0.79	99
L21	Upstream	1.47	1.40	1.46	1.34	1.16	1.00	0.93	0.75	99
	Downstream	1.47	1.68	1.49	1.34	1.18	1.01	0.91	0.77	99
M22	Upstream	1.60	1.74	1.62	1.49	1.30	1.14	1.07	0.88	102
	Downstream	1.64	1.57	1.66	1.53	1.36	1.19	1.07	0.92	99
L22	Upstream	1.55	2.17	1.57	1.43	1.24	1.07	0.98	0.80	101
	Downstream	1.42	1.66	1.43	1.31	1.13	0.95	0.83	0.69	99
L23	Upstream	1.74	1.72	1.74	1.56	1.37	1.18	1.04	0.86	100
	Downstream	1.71	1.80	1.70	1.55	1.36	1.17	1.03	0.88	101

Section I.D.: 24-I10-4

Date: 5/26/2023

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream	1.04	1.29	1.07	0.90	0.75	0.61	0.53	0.45	103
	Downstream	1.07	1.33	1.07	0.91	0.77	0.63	0.55	0.50	100
L11	Upstream	0.93	1.03	0.95	0.82	0.71	0.61	0.55	0.47	102
	Downstream	0.94	1.00	0.95	0.84	0.73	0.64	0.55	0.49	99
M11	Upstream	1.13	1.31	1.19	1.04	0.91	0.76	0.66	0.56	105
	Downstream	1.17	1.41	1.22	1.07	0.93	0.75	0.66	0.57	96
L11(23)	Upstream	1.07	1.28	1.11	0.95	0.82	0.73	0.66	0.57	103
	Downstream	1.08	1.24	1.10	0.96	0.83	0.75	0.65	0.62	98
L12	Upstream	1.08	1.21	1.10	0.95	0.82	0.71	0.64	0.57	102
	Downstream	1.08	1.18	1.10	0.96	0.84	0.67	0.62	0.57	98
S12	Upstream	0.99	1.28	1.03	0.87	0.72	0.61	0.52	0.46	104
	Downstream	1.02	1.25	1.05	0.88	0.75	0.62	0.54	0.47	97
M12	Upstream	1.07	1.08	1.09	0.93	0.77	0.66	0.56	0.52	102
	Downstream	1.06	1.10	1.08	0.92	0.77	0.64	0.57	0.49	102
S21	Upstream	1.51	1.75	1.54	1.31	1.11	0.90	0.79	0.66	102
	Downstream	1.51	1.75	1.53	1.32	1.11	0.93	0.79	0.69	98
M21	Upstream	1.32	1.47	1.32	1.15	0.98	0.84	0.74	0.63	100
	Downstream	1.29	1.51	1.31	1.14	0.99	0.81	0.71	0.61	98
S22	Upstream	1.29	1.54	1.32	1.13	0.96	0.81	0.72	0.61	103
	Downstream	1.30	1.61	1.34	1.17	1.00	0.84	0.74	0.63	97
L21	Upstream	1.60	1.77	1.64	1.41	1.21	1.03	0.89	0.76	103
	Downstream	1.61	1.87	1.63	1.41	1.22	1.01	0.88	0.76	98
L21(13)	Upstream	1.63	1.95	1.66	1.46	1.23	1.02	0.87	0.75	102
	Downstream	1.63	1.87	1.64	1.42	1.21	1.02	0.87	0.76	99
L22	Upstream	1.53	1.69	1.56	1.39	1.25	1.10	0.99	0.87	102
	Downstream	1.52	1.67	1.59	1.44	1.29	1.14	1.02	0.91	96
M22	Upstream	3.05	3.41	3.31	2.96	2.60	2.25	1.93	1.65	108
	Downstream	3.29	3.55	3.35	3.03	2.65	2.24	1.93	1.86	98

Section I.D.: 24-I10-4

Date: 7/16/2024

Cracks		W8	W1	W2	W3	W4	W5	W6	W7	LTE
S11	Upstream	1.11	1.28	1.15	0.97	0.81	0.66	0.59	0.49	104
	Downstream	1.13	1.39	1.16	0.98	0.81	0.68	0.58	0.51	98
M11	Upstream	1.27	1.47	1.30	1.14	0.96	0.78	0.66	0.55	103
	Downstream	1.29	1.59	1.32	1.14	0.95	0.78	0.69	0.55	97
L11	Upstream	1.14	1.34	1.15	1.00	0.84	0.69	0.57	0.52	102
	Downstream	1.13	1.39	1.15	1.01	0.85	0.71	0.63	0.52	98
S12	Upstream	1.10	1.47	1.14	0.95	0.78	0.62	0.49	0.46	104
	Downstream	1.13	1.36	1.14	0.98	0.78	0.65	0.54	0.48	98
M12	Upstream	1.23	1.30	1.23	1.04	0.85	0.68	0.60	0.49	101
	Downstream	1.20	1.45	1.27	1.03	0.84	0.67	0.51	0.49	94
L12	Upstream	1.10	1.25	1.10	0.97	0.80	0.68	0.64	0.53	100
	Downstream	1.03	1.30	1.04	0.92	0.77	0.64	0.58	0.51	99
S21	Upstream	1.23	1.44	1.28	1.11	0.88	0.76	0.64	0.56	104
	Downstream	1.25	1.46	1.26	1.11	0.90	0.74	0.64	0.54	99
M21	Upstream	1.29	1.32	1.27	1.11	0.93	0.76	0.69	0.59	98
	Downstream	1.25	1.45	1.27	1.09	0.92	0.76	0.71	0.58	98
L21	Upstream	1.57	1.68	1.58	1.39	1.18	1.00	0.91	0.76	101
	Downstream	1.55	1.68	1.56	1.40	1.18	1.02	0.92	0.77	99
S22	Upstream	1.46	1.81	1.50	1.29	1.07	0.89	0.81	0.65	102
	Downstream	1.45	1.63	1.51	1.31	1.08	0.91	0.78	0.67	96
M22	Upstream	2.03	2.23	2.11	1.91	1.68	1.44	1.27	1.08	104
	Downstream	2.08	2.31	2.16	1.94	1.69	1.43	1.26	1.05	96
L22	Upstream	1.64	5.38	1.67	1.52	1.39	1.22	1.13	0.99	102
	Downstream	1.60	1.80	1.65	1.51	1.35	1.19	1.09	0.94	97