



NORTHWESTERN UNIVERSITY

PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

H\$ HP S7'\*( / ': H!5%! -1(' '41( -!-!, 5 +- (10\*!, 5 0\* / +1( \*%0, 1B - '! ?10C <P0@ 0' 1(D4!1(3 67 ASME  
B 1\$1\$

I\$ #P S7'\*( / ': #+A! -1(' '41( -!-!, 5 +- (10\*!, 5 0\* 1B - '! ?10C <P0@ +1 ?(' ' 0' 1(D4!1(3 67 ASME  
B 1\$E\$

1\$C ABBREVIATIONS

A\$ HDPE: %!5%!3( , ' !\*7 -+27(\*%72( , (

B\$ RTRP: 1(!, .+1) (3 \*%(1 / +' (\*\*!, 5 1( '!, -20' \*!)

C\$ RTRF: 1(!, .+1) (3 \*%(1 / +' (\*\*!, 5 1( '!, .! \*\*!, 5'

D\$ WOG: A0\*(18 +! 0, 3 50'

1\$B DE#IVERY! STORAGE AND HAND#ING

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1\$ C+ / -27 A&#x27; +, ' &, K ASME B 1&#x27; B4&#x27; 3&#x27; 5 S(1;&#x27;) ( ' P&#x27;-&#x27; 5 / ASME B 1&#x27;18 P+A(1 P&#x27;-&#x27; 5 L \$

2\$ C(1&#x27;.7 \*%O\* (0)% A(23(1%O' -0' ' (3 AWS D40&#x27;.&#x27;)O\*&#x27;+, \* ('\*' .+1 A(23&#x27;.5 -1+)( ' ' ( &#x27; , ;+2; (3 0,3 \*%O\* ) (1&#x27;.&#x27;)O\*&#x27;+, &#x27; )411(, \*\$

E\$ ASME C+ / -2&#x27;0, )(: C+ / -27 A&#x27;+ [ !S" # \$%&#x27;(') \$uilding Ser\*ices +iping) / !S" # \$%&#x27;&#x27; +ower +iping .+1 / O\*(1&#x27;02'8 -1+34)\*'8 0,3 &#x27;, '\*O20\*&#x27;+, \$

F\$ ASME C+ / -2&#x27;0, )(: S0.( \*7 ;02; (' 0,3 -1(' '41( ; (' ' (2' ' %O22 6(01 0--1+-1&#x27;O\*( ASME 206(2' \$

1\$8 SUBMITTA#S

A\$ MO,4.0)\*41(1' || #&#x27;(10\*41( 0,3 D0\*0 ' %O22 6( ' 46 / &#x27;\*(38 0' +, ( -0)<05(8 .+1 -&#x27;- ('8 .&#x27;\*&#x27;.5' 0,3 0--41\*(, 0, ) ('8 &#x27;, )243&#x27;.5 I+&#x27;, \*&#x27;.5 / O\*(1&#x27;02'8 &#x27;, '420\*&#x27;+, 8 %O,501' 0,3 +\*(1 / &#x27;)(20, (+4' &#x27;( / ' \$

1\$E APP#ICAB#E PUB#ICATIONS

A\$ T%( -46&#x27;)O\*&#x27;+, ' 2&#x27;'\*(3 6(2+A .+1 / 0 -01\* +. \*%&#x27;' ' - ( )&#x27;.&#x27;)O\*&#x27;+, \*+ \*( ( :\*(, \* 1.(1(, ) (3\$ T%( -46&#x27;)O\*&#x27;+, ' 01( 1(. (11(3 &#x27;, \*( (\*: \* 67 60' &#x27;) 3( ' &#x27;5, 0\*&#x27;+, +, 27\$

F(3(102 S- ( )&#x27;.&#x27;)O\*&#x27;+, ' ?F(3\$ S- ( )\$&#x27;:

A!A!6000B NOT 1 F10 / ('8 C+; (1'8 G10\*&#x27;.58 S\*(-'8 S4 / - 0,3 C0\*)% BO' &#x27;.8 MO, %+2(

#!S!12B S)1((, &#x27;.58 I, ' ( ) \*8 N+, / (\*O22&#x27;)

M&#x27;2&#x27;O17 S- ( )&#x27;.&#x27;)O\*&#x27;+, ' ?M&#x27;2&#x27; S- ( )\$&#x27;:

MI#!S!E01 S%+)< T('' H&#x27;I\$ ?H&#x27;5% I / -0)\*&#x27; S%&#x27;-6+013 MO)%&#x27;, (178 ED4&#x27;- / (, \* 0,3 S7'\* ( / ' )

A / (1&#x27;)0, S+)&#x27;(\*7 .+1 T(' \*&#x27;.5 0,3 MO\*(1&#x27;02' ?ASTM&#x27;:

A 6/A 6M!08 C016+, S\*14)\*4102 S\*( (2

ACG/ACGM!EE?200E&#x27; F(11&#x27;\*&#x27;) M022(062( I1+, C0' \*&#x27;.5'

AB /AB M!10 P&#x27;- (8 S\*( (28 B20)< 0,3 H+\*!D&#x27;- - (38 N&#x27;, )!C+0\*(38 W(23(3 0,3 S(0 / 2(' ' )

A10B/A10BM!100 C016+, S\*( (2 F+15&#x27;.5' .+1 P&#x27;-&#x27;.5 A- -2&#x27;)O\*&#x27;+, ' )

A106/A106M!10 S(0 / 2(' ' C016+, S\*( (2 P&#x27;- ( .+1 H&#x27;5%!T( / - (10\*41( S(1;&#x27;)&#x27; )

A126!0C?200E&#x27; G107 I1+, C0' \*&#x27;.5' .+1 V02; ('8 F20,5 ('8 0,3 P&#x27;- ( F&#x27;\*&#x27;.5'

A1 E/A1 EM!0C?2010&#x27; E2( ) \*&#x27;)&#x27;!F4' &#x27;+, ?A1)&#x27;!W(23(3 S\*( (2 P&#x27;- ( ?NPS C 0,3 O; (1&#x27; )

A16G!EE?200E&#x27; S\*0&#x27;.2( ' ' 0,3 H(0\*!R( ' &#x27;' \*&#x27;.5 C%1+ / &#x27;4 / !N&#x27;)< (2 S\*( (2 P20\*(8 S%( (\*8 0,3 S\*1&#x27;- )

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A1E /A1E M!100

A22+7!S\*( (2 0, 3 S\*0i, 2( ' ' S\*( (2 B+2\*% , 5 .+1 H!5% T( / - (10\*41( +1  
H!5% P1( ' ' 41( S(1; i) ( 0, 3 O\*%(1 S- ( )i02 P41 -+ ' ( A - - 2i) 0\*%+ , ' )

A1EC/A1ECM!100

C016+ , 0, 3 A22+7 S\*( (2 N4\* ' .+1 B+2\* ' .+1 H!5% P1( ' ' 41( +1 H!5%

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C1126!100 F0) (3 +1 U, .0) (3 R!5!3 C (24201 P% ( , +2! ) T% (1 / 02 I, ' 420\*!+,

C11 6!10 F2( :!62(8 #+A P(1 / (0, ) ( V0--+1 R(\*013(1' .+1 T% (1 / 02 I, ' 420\*!+,

D2EE6!01?200G@ F!20 / ( , \*!W+4, 3 F!6(1520' ' ?G20' '!F!6(1!R(, .+1) (3 T% (1 / + ' (\*\*!, 5!R( '!, @ P!- (

DC02C!0B M0)%!, ( M03( F!6(1520' ' ?G20' '!F!6(1!R(, .+1) (3 T% (1 / + ' (\*\*!, 5 R( '!, @ F20, 5( ' )

E8C!106 S41.0) ( B4!, !, 5 C%010)\*(1! '\*!)' +. B4!23!, 5 M0\*(1!02' )

A / (1!)0, S+)!(\*7 +. M( )%0, ! )02 E, 5!, ((1' ?ASME@:

B1\$20\$1!2006 P!- ( T%1(03' 8 G( , (102 P41--+ ( ?1, ) )%@

B16\$ !2006 M022(062( I!+, T%1(03(3 F!\*\*, 5': C20' ' ( ' 1B0 0, 3 00

B16\$C!2006 G107 I!+, T%1(03(3 F!\*\*, 5': ?C20' ' ( ' 12B 0, 3 2B0@

B16!B!200E P!- ( F20, 5( ' 0, 3 F20, 5(3 F!\*\*, 5': NPS 1/2 \*%1+45% NPS 2C M(\*1!)/I, ) % S\*0, 3013

B16\$E!200G F0)\*+17!M03( W1+45%\* B4\*\*A(23!, 5 F!\*\*, 5' )

B16\$11!200E F+15(3 F!\*\*, 5' 8 S+)<(\*!W(23!, 5 0, 3 T%1(03(3

B16\$21!200B N+, / (\*022) F20\* G0' <(\*' .+1 P!- ( F20, 5( ' )

B18\$2\$1!2010 SD401(8 H(:8 H(0;7 H(:8 0, 3 A' <(A H(03 B+2\* ' 0, 3 H(:8 H(0;7 H(:8 H(: F20, 5(8 #+6(3 H(038 0, 3 #05 S)1(A' ?I, ) % S(1!(' @

B 1\$1!2010 P+A(1 P!-!, 5

B 1\$E!2008 B4!23!, 5 S(1;!) ( ' P!-!, 5

BC0\$1000!200E P1( ' ' 41( G045( ' 0, 3 G045( A\*0)% / ( , '\* )

A / (1!)0, W(23!, 5 S+)!(\*7 ?AWS@:

B2\$1!B2\$1M!BMG!200E B0' ( M(\*02 G1+4-!, 5 .+1 W(23!, 5 P1+) (341( ' 0, 3 P(1.+1 / 0, ) ( H402!.!)0\*!+,

D10\$12/D10\$12M!2000 G4!3( .+1 A(23!, 5 M!23 S\*( (2 P!- (

A / (1!)0, A' ' +)!0\*!+, +. S\*0\*( H!5%A07 0, 3 T10, ' -+1\*0\*!+, O.!)!02' ?AASHTO@:

M 00!0 I, +150, ! ) N!, )!R!)% P1! / (1

M0, 4.0)\*41(1!! S\*0, 3013!00\*!+, S+)!(\*7 ?MSS@:



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H\$ F20,5( B+2\* 0,3 N4\*': ASME B18\$2\$18 )016+, \*( (28 4,2( ' ' +%(1A&' ( &,3&)0\*(3\$

2\$2 FIBERG#ASS PIPE AND FITTINGS

A\$ RTRP: ASTM D2EE68 .&20 / ( ,\*!A+4,3 -&- ( A&\*& \*0- (1(3 6(22 0,3 ' -&5+\* ( ,3' .+1 03%('&; ( I+&, \*'\$

B\$ RTRF: C+ / -1( ' ' &+, +1 ' -107!4- /)+, \*0)\* / +23(3 +. ' 0 / ( / 0\*(1&028 -1( ' ' 41( )20' '8 0,3 I+&, &, 5 / (%+3 0' -&- (\$

C\$ F&6(1520' ' P&- ( A3%('&; (: F41, &'%(3 +1 0' 1( )+ / / ( ,3(3 67 \*( -&- ( / 0,4.0)\*41(1\$

D\$ F20,5( ' : ASTM DC02C8 .422! .0) ( 50' <(\*' ' 4&\*062( .+1 \*(% ( ' (1; &) (8 / &, & / 4 / 1/8 &, ) % ? \$2 / / @ \*%&& ) <8 60!GO 341+ / (\* (1\$ ASTM A 0G8 G103( B8 % (: !%(03 6+2\*' A&\*& A0' % (1'\$

2\$ CONDUIT PIPING SYSTEM

A\$ C+, 34&\* P&-&, 5 S7'\*( / : F0)\*+17!.061&)0\*(3 0,3 0' ' ( / 62(38 0&1\*5%\* 0,3 A0\*(1\*5%\*8 310&, 062(8 -1( ' ' 41(!\* ( '\* (3 -&-&, 5 A&\*& )+, 34&\*8 &, , (1 -&- ( ' 4-- +1\*' 8 0,3 &, ' 420\*(3 )011&(1 -&-&, 5\$ F061&)0\*( ' + &, ' 420\* &+, ) 0, 6( 31&(3 &, -20) ( 67 .+1) &, 5 317 0&1 \*%1+45% )+, 34&\* \$

B\$ C011&(1 P&- ( I, ' 420\* &+, :

1\$ M&, (102!W++2 P&- ( I, ' 420\* &+, : M&, (102 +1 520' ' .&6(1' 6+, 3(3 A&\*& 0 \*(% (1 / +' (\*\*&, 5 1( ' &, \$ C+ / -27 A&\*& ASTM CBCG8 [ Type 2) 3. / deg 4 (1.1 deg , ) / Type 2) &- / / deg 4 (01 ( deg , ) 8 G103( A\$

0\$ B0,3' '%022 6( ASTM A6668 T7- ( 0C8 ' 0&, 2( ' ' \*( (28 /C &, ) % ? 1E / / @ A&3(8 0\$020

NRcmU3.25270(E)5.73728(S)5.73728(T) - 0 67556(E) -4.28 86(RcmU3.25270 cmU3.25270 ) -2.5353

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2\$C #OOSE!FI## INSU#ATION

A\$ G10,42018 2++' (1.822 &, '420\*%+,: I,+150,&)8 ,+,\*+:&)8 ,+,.20 / / 062(8 '+3&4 / -\*0' ' &4 / 024 / &,4 /

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TAB#E 1			
M, / 4 / P - ( 1, ' 420* +, T% ) <, ( ' ' / / ? , ) % ( ' )			
F+1 S*( 0 / 16 *+ C08 - ' ? 110 *+ 2800 <P0 505 (			
N+ / &, 0? P - ( D / ( * ( 1 1 , ) % ( ' ? / / )	MPT!PC MPT!PF	D ( ? * 0	T% ( 1 / + ! 12 S4 - ( 1 C0? ( / -
1 ? 2B	2 ? B0	2!1/2 ? 6B	C ? 100
1!1/2 ? C0	2 ? B0	2!1/2 ? 6B	C ? 100
2 ? B0	2!1/2 ? 6B	!1/2 ? 8B	C!1/2 ? 110
2!1/2 ? 6B	2!1/2 ? 6B	!1/2 ? 8B	C!1/2 ? 110
? 80	? GB	C ? 100	B ? 12B
C ? 100	? GB	C ? 100	B ? 12B
B ? 12B	? GB	C ? 100	B ? 12B
6 ? 1B0	!1/2 ? 8B	C!1/2 ? 110	B!1/2 ? 1 B
8 ? 200	!1/2 ? 8B	C!1/2 ? 110	B!1/2 ? 1 B
10 ? 2B0	C ? 100	B ? 12B	6 ? 1B0
12 ? 00	C ? 100	B ? 12B	6 ? 1B0
1C ? B0	C ? 100	B ? 12B	6 ? 1B0
16 ? C00	C ? 100	B ? 12B	6 ? 1B0
18 ? C B0	C ? 100	B ? 12B	6 ? 1B0

N+\* ( ' :

1.3583 ( ) 0.452.9322 ( 1 , 307 ( 4 ) 0.72.7347 ( B ) # 2.7347 ( 3 ) % ( ' ) 0.07.00239 ( / 5614.9756 ( 0 ) 057A3007 ( 1 ) 4.7147 ( ? ) 4.7047 ( ( ? ) 0.71307 ( 1 ) - 5.00129 ( ) - ( 6 ) 0.7

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E\$ I, '420\*+ , B0, 3i, 5 0, 3 J0) < (\*: ASTM A16G8 '\*0i, 2(' ' '(2 60, 3' 0, 3 )2i- '8 0\* 2(0' \* 0\$B i, )%(' ?1 / / @ A&3(8 ? OC '\*0i, 2(' ' '(208 / 0: i / 4 / ' -0)i,

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- 1\$ T1(,)%+;(1': P1()0'1\*(,+.1)(3)+,)1\*( '())\*+, '8' (\*+ (:&'\*,5 5103(8 .20\* 0, 3 \*14( 0\* 022 -+&, '\* +. )+,\*0)\* +, \*1(,)% A022Q \*1(,)% 0,3 )+;(1\*+ .+1/ 0 A0\*(1\*5%\* (, ; (2+- ( A%(, 0' ' ( / 62(3\$
- 2\$ WO\*(1-1++&,5: A- -27 \*+ 022 6(2+A 5103( -+1\*+, ' +. \*( \*1(,)%\$
- \$ G0'<(\*' 0,3 '(020,\*': ASTM CE208 1/C &,)% ?6 / / @ \*%&<, (+-1(, ( -03' A&\*& 0 / &, & / 4 / A&3\*%+. 2 &,)% (' ?B0 / / @ 6(\*A(, )+;(1' 0,3 \*+-' +. A022'Q (20'+ / (1&) '(020,\*' \*%0\* 01( 0;0&2062( 0' 0 +, ( +1 \*A+ )+ / -+, (, \* '7'\*( / \$ A'-%02\*&) '(020,\*' 01( ,+\* - (1 / &\*(3\$ S(020,\*' / 4'\* 1('&'\* B0R \*+\*02 l+&, \* / +; ( / (, \*\$ N+, !'055&, 5 '(020,\* / 4'\* 6( 4' (3 .+1 ; (1&)02 l+&, \*'\$ S(2.12(; (2&, 5 '(020,\* / 4'\* 6( 4' (3 .+1 \*1(,)% \*+- 64\*\* l+&, \*'\$

2\$E STEAM CARRIER PIPING

A\$ P&- (: K ASTM AB 8 \*( (28 ' (0 / 2(' '8 G103( B / +1 / ASTM A1068 G103( B8 (2() \*1&) 1('&'\*0,)( A(23(3 / +1 / ASTM AB 8 G103( B8 S)% (342( C0 L \$ S\*0, 3013 A(15%\* - (1 / &\*(3 .+1 -&- ('&0(' 12 &,)% (' ? 00 / / @ 0, 3 06+; (\$ G103( F8 .41, 0) ( 64\*\*!A(23(3 -&- (8 &' ,+\* - (1 / &\*(3\$

B\$ J+&, '\*:

1\$ I, \*1(,)%(' 0, 3 3&1()!\*!641&(3 '7'\*( / ': B4\*\*!A(23

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1\$ I, T1(,)%( ' 0,3 3!1()!641! (3 ' 7'\*( / ': B4\*\* A(23 l+!,\*' \$ S+)<(\* A(23 !' 1(D4!1(3 .+1 -!-(  
'!0(' 2 !,)%(' ?B0 / / @ 0,3 6(2+A\$ M0,4.0)\*41(1!l' '\*0,30!3 '2!3!,5! 50'<(\* (3 l+!,\*' 01(  
-(1 / !\*\* (3 6(\*A(, .0)\*+17!.06!!)0\*(3 '()!+, ' +. 3!1()\* 641!(3 WS# '7'\*( / \$ N+ l+!,\*' 01(  
02+A(3 !, .0)\*+17!.06!!)0\*(3 '\*!0!5%\* '()!+, ' +. -1(!,5!, ((1(3 3!1()!641!(3 '7'\*( / '\$



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3(\*02(3 +, \*( )+, \*10)\* 310A, 5' \$ G43( 2+)0\*+, ' / 4' )+, .+1/ \*+ 1(+)/ / (, 30\*+, ' +. (: -0, ' +, l+, \* / 0, 4.0)\*41(1\$

2\$1 BA## JOINTS

A\$ F0)\*+17 642\* 3(;&)( '8 &, '(1\*(3 &, -&- ( 2&, ( +.. '( \*' &, 51+4- ' +. \*A+ +1 \*(1( ( 0' '%+A, \*+ 06'+16 )7)2)02 -&- ( / +; ( / (, \* A%)% 1('42\* .1+ / \*(1/ 02 (: -0, ' &+, 0, 3)+, \*10)\*&+, \$

B\$ M&, & / 4 / ' (1;&)( 1(D4&1( / (, \*' '%022 6( 10\*(3 2B0 - ' & ?1G2B <P0@8 CB0 3(5 F ?2 2 3(5 C@8 )+, \*&, 4+4' +, \*'(0/ 0, 3)+, 3(, '0\*( \$

C\$ S46 / &\* &, 3(- (, 3(, \*) (1\*&.)0\*+, \*%0\* ' & / @201 4, &\* %0; ( -0' '(3 \*(% (. +22+A&, 5\*( ' \*' A&\*% , + 2(0<' \$

1\$ #+A P1( ' '41( # (0<05( T( ' \* : M&, & / 4 / 6 - ' & ?C0 <P0@ ' 0\*410\*(3 ' \*(0 / .+1 60 307' \$

2\$ #. ( C7)2( F2( : T( ' \* : M&, & / 4 / 8000 .2( : )7)2( ' 0\* 2B0 - ' & ?1G2B <P0@ ' 0\*410\*(3 ' \*(0 / \$

\$ T%(1/ 02 C7)2&, 5 T( ' \* : M&, & / 4 / 100 )7)2( ' .1+ / 0\* / + ' -(1&) -1( ' '41( \*+ +- (10\*&, 5 -1( ' '41( 0, 3 60)< \*+ 0\* / + ' -(1&) -1( ' '41( A&\*% ' 0\*410\*(3 ' \*(0 / \$

C\$ E, ;&1+, / (, \*02 S%+)< T( ' \* : MI# S E01\$

B\$ V&610\*+, T( ' \* : T( ' \* .+1 1G0 %+41' +, (0)% +. \*(1( ( / 4\*40227 - (1- (, 3&)4201 0: ( ' 0\* 2B \*+ 12B HNQ 0\$OB \*+ 0\$10 &, )% ?1 \*+ 2 / / @ 3+462( 0 / -2&\*43( +, 0 ' &, 52( 6022 l+&, \* 0, 3+, 0 \*%1( ( 6022 l+&, \* +.. ' (\*\$

D\$ J+&, \*' : ASME B 1\$1:

1\$ C0' \* +1 .+15(3 )0'6+, '\*( (2 A&\*% A(23(3 (, 3' \$

2\$ S\*0, 3013 A(&5%\* -&- ( A022 \*%&)<, ( ' '\$

\$ M&, & / 4 / 0, 54201 / +; ( / (, \*)0-06&2&\*7: 1B3(51(( ' 0, 3 60 3(51(( ' 1+\*0\*+, 02 / +; ( / (, \*\$

C\$ G0' <(\*' : N+, 0' 6( ' \*+ '\$

B\$ P0)<&, 5 &, l( )\*&+, 3(;&)( '8 &. -1+; &3(3: A22+A &, l( )\*&+, 4, 3(1 .422 2&, ( -1( ' '41( \$ P1+; &3( +, ( 7(01 '4- -27+. -0)<&, 5\$

2\$1C VA#VES

A\$ G0\*( V02; ( ' ?ASTM A126@:

1\$ T7- ( 101 '%022 %0; (:

0\$ C0' \* \*( (2 6+378 10\*(3 1B0 - ' & ?102B <P0@ 0\* B00 3(5 F ?260 3(5 C@8 11!1/2 \*+ 1 - (1)(, \*)%1+ / &4 / ' \*0&, 2( ' ' \*( (2 .2( : &62( A(35( 0, 3 %013 .0) (3 ?' \*(22&\*( @ +1 , &)<(2 )+-- (1 022+7 ' (0\*' 8 1B0 - ' & ?102B <P0@ .20, 5(3 (, 3' 8 OSSY8 1&' &, 5 '\*( / 8 6+2\*(3 6+, , (\*\$

6\$ F0)\*+17 &, '\*02(3 52+6( ;02; (3 67-0' ' +, 022 ' \*(0 / ;02; ( ' 2015(1 \*%0, &, )%( ' ?80 / / @ \$

)\$ D1&22 0, 3\*0- 6+ ' ' ( ' .+1 )+, , ( )\*&+, +. 310&, ' A%(1( '%+A, \$

2\$ T7- ( 102 &' , +\* 4' (3\$

\$ T7- ( 10 '%022 %0; (:

0\$ C0' \* &1+, 6+378 C20' ' B8 10\*(3 .+1 12B - ' & ?8B0 <P0@ ' 0\*410\*(3 ' \*(0 / 8 200 - ' & ?1 GB <P0@ WOG8 61+, 0( +1 61+, 0( .0) (3 A(35( 0, 3 ' (0\*' 8 12B - ' & ?8B0 <P0@ ASME .20, 5(3 (, 3' 8 OSSY8 1&' &, 5 '\*( / 8 6+2\*(3 6+, , (\*8 1(, ( A062( ' (0\* 1&, 5' \$

C\$ T7- ( 10C '%022 %0; (:

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0\$ B1+,0( 6+378 10\*(3 .+1 200 - ' & ?1 GB <P0@ '0\*410\*(3 '\* (0 / 8 C00 - ' & ?2GB0 <P0@ WOG8 61+,0( A(35(' 0,3 M+, (2 +1 '\*0&,2(' '\* (2 ' (0\*'8 %1(03(3 ( , 3'8 1&'&,5 '\* ( / 8 4, &+, 6+, , (\*\$

B\$ T7- ( 10B &' , +\* 4' (3\$

6\$ T7- ( 106 '%022 %0; (:

0\$ F+15(3 '\* ( (2 6+378 10\*(3 .+1 00 - ' & ?20B0 <P0@ 0\* C20 3(5 F ?216 3(5 C@ / &, & / 4 / C20 ' ' 600 - ' & ?C1 0 <P0@ +1 C20 ' ' 800 - ' & ?BB00 <P0@8 %013( , (3 '\*0&,2(' '\* ( (2 +1 '0\*(22&\*( A(35( 0,3 ' (0\*'8 %1(03(3 ( , 3'8 OSSY8 1&'&,5 '\* ( / 8 6+2\*(3 6+, , (\*\$

B\$ G2+6( V02; (' ?ASTM A126@:

1\$ T7- ( 201 '%022 %0; (:

0\$ C0' \* '\* ( (2 6+378 10\*(3 1B0 - ' & ?102B <P0@ 0\* B00 3(5 F ?260 3(5 C@8 11!1/2 \*+ 1 - (1) ( , \* )%1+ / &4 / '\*0&,2(' '\* ( (2 +1 '\* (22&\*( 3&' ) 0,3 ' (0\*8 1B0 - ' & ?102B <P0@ ASME .20,5(3 ( , 3'8 OSSY8 1&'&,5 '\* ( / 8 6+2\*(3 6+, , (\*8 1( , (A062( ' (0\* 1&,5 '\$ D1&22 0,3 \*0-6+ ' ' ( ' .+1 )+, , ( )&+, +. 310&, '\$

2\$ T7- ( 202 &' , +\* 4' (3\$

\$ T7- ( 20 :

0\$ C0' \* &1+, 6+378 10\*(3 .+1 12B - ' & ?8B0 <P0@ '0\*410\*(3 '\* (0 / 8 200 - ' & ?1 GB <P0@ WOG8 61+,0( +1 61+,0(!.0)(3 3&' ) ?T(.2+, +1 )+ / -+ '&\*&+, .0)&,5 - (1 / &\*\*(3@ 0,3 ' (0\*8 12B - ' & ?8B0 <P0@ ASME .20,5(3 ( , 3'8 OSSY8 1&'&,5 '\* ( / 8 6+2\*(3 6+, , (\*8 1( , (A062( ' (0\* 1&,5 '\$

C\$ T7- ( 20C:

0\$ ASTM B618 61+,0( 6+378 10\*(3 .+1 200 - ' & ?1 GB <P0@ '0\*410\*(3 '\* (0 / 8 C00 - ' & ?2GB0 <P0@ WOG8 %013( , (3 '\*0&,2(' '\* ( (2 3&' ) 0,3 ' (0\*8 %1(03(3 ( , 3'8 1&'&,5 '\* ( / 8 4, &+, 6+, , (\*8 1( , (A062( ' (0\* 1&,5 '\$

C\$ C% (< ;02; (' ?ASTM A126@:

1\$ T7- ( C01 '%022 %0; (:

0\$ C0' \* '\* ( (2 6+378 'A&,5!\*7- (8 10\*(3 .+1 1B0 - ' & ?102B <P0@ 0\* B00 3(5 F ?260 3(5 C@8 '\*0&,2(' '\* ( (2 +1 '\*0&,2(' '\* ( (2 ! .0)(3 3&' ) 0,3 ' (0\*8 1B0 - ' & ?102B <P0@ ASME .20,5(3 ( , 3'8 6+2\*(3 )+; (18 1( , (A062( 3&' )\$

2\$ T7- ( C02 &' , +\* 4' (3\$

\$ T7- ( C0 '%022 %0; (:

0\$ C0' \* &1+, 6+378 C20 ' ' B& 'A&,5!\*7- (8 10\*(3 .+1 12B - ' & ?8B0 <P0@ '0\*410\*(3 '\* (0 / 8 200 - ' & ?1 GB <P0@ WOG8 61+,0( +1 61+,0(!.0)(3 3&' ) 0,3 ' (0\*8 12B - ' & ?8B0 <P0@ ASME .20,5(3 ( , 3'8 6+2\*(3 )+; (18 1( , (A062( 3&' ) 0,3 ' (0\*\$

C\$ T7- ( C0C '%022 %0; (:

0\$ B1+,0( 6+378 'A&,5!\*7- (8 10\*(3 .+1 200 - ' & ?1 GB <P0@ '0\*410\*(3 '\* (0 / 8 C00 - ' & ?2GB0 <P0@ WOG8 61+,0( 3&' )8 %1(03(3 ( , 3'8 1(51&,3&,5 3&' )\$



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JOB # \_\_\_\_\_

FOR: \_\_\_\_\_  
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PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

2\$1G STRAINERS\$ Y TYPE

A\$ P1+;3( 0' '%+A, +, '(0/ 0,3)+,3(,'0\*( -&-&,5 '7'\*( / '\$

B\$ I,)243(+-(, (,3 1(/+;062( )72&,31&)02 ')1((, 0,3 \*%1(03(3 62+A +.. )+, , ( )\*+,\$

C\$ F+1 \*(0/ '(1;&) ( 4- \*+ 1B0 - '& ?102B <P0@ 0,3 0\* 31&- \*10- '8 '\*10&, (1 '%022 6( 10\*(3 .+1 / &, & / 4 / 1B0 - '& ?102B <P0@ '0\*410\*(3 \*(0/Q 10\*(3 .+1 1B0 - '& ?102B <P0@ .20,5(3 (,3'8 )0'\* \*(28 .+1 -&- ( '0( ' 06+; ( 2 &, )%( ' ?B0 / / @ \$ U( ' )0'\* &1+, +1 61+,0(8 10\*(3 .+1 2B0 - '& ?1G2B <P0@ '0\*410\*(3 \*(0/8 \*%1(03(3 (,3'8 .+1 -&- ( '0( ' 2&, )%( ' ?B0 / / @ 0,3 4,3(1\$

D\$ F+1 )+,3(,'0\*( '(1;&) (8 '\*10&, (1 '%022 6( 10\*(3 .+1 12B - '& ?8B0 <P0@ '0\*410\*(3 \*(0/8 1GB - '& ?1200 <P0@ WOG\$ P1+;3( 12B - '& ?8B0 <P0@ .20,5(3 (,3'8 )0'\* &1+,8 .+1 -&- ( '0( ' 06+; ( 2 &, )%( ' ?B0 / / @ \$ P1+;3( )0'\* &1+, +1 61+,0(8 \*%1(03(3 (,3'8 .+1 -&- ( '0( ' 2&, )%( ' ?B0 / / @ 0,3 4,3(1\$

E\$ S\*10&, (1 ')1((, '%022 6( '0&,2(' '\*( (28 A&% 0 .1(( 01(0 ,+\* 2(' ' %0, 2 1/2 \*& / ( ' .2+A 01(0 +. -&- (\$ D&0 / (\* (1+ .+-(, &,5' '%022 6( 0\$0B &, )% ?1\$ / / @ +1 2(' ' +, \*(0/ '(1;&) ( 0,3 0\$06 &, )% ?1\$B / / @ +1 2(' ' +, A0\*(1' (1;&) (\$

F\$ I,)243( 50\*( \*7-( ;02; ( 0,3 D4& )< )+4-2( %+' ( )+, , ( )\*+ , +, 022 62+A+.. )+, , ( )\*+ , \$

2\$18 SAFETY VA#VES AND VENT CONNECTORS

A\$ S0.( \*7 ;02; ( ' : C+ ,.+1/ \*+ \*( ( 1(D4&1 ( / ( , \*' +. ASME B+&2(1 0,3 P1(' '41( V(' ' (2 C+3( ?S( )\*+ , VIII8 U , &1(3 P1(' '41( V(' ' (2' @ 0,3 6( 0--1+; (3 67 \*( NO\*+ , 02 B+013 +. B+&2(1 0,3 P1(' '41( V(' ' (2 1, ' - ( ) \*+1 '\$

B\$ R(2& ;&,5 )0-0)&\*7: N+\* 2(' ' %0, \*%0\* '%+A, +, \*( ( 310A&,5' A&% 0 -1(' '41( 1&' ( 06+; ( ' (\* -1(' '41( ,+\* \*+ ( : ) ( (3 10 - (1) ( , \*+ . ' (\* -1(' '41(\$

C\$ P1+;3(8 0\* \*( 3&' )%015( +. (0)% '0.( \*7 ;02; (8 0' - ( )&02 .2( :&62( )+, , ( ) \*+1 0\*\*0)% (3 \*+ \*( ; ( , \* -&- ( 0,3 \*( '0.( \*7 ;02; (\$ M42&!-27 '\*0&,2(' '\*( (2 6(22+A'8 .422 &, \*(1,02 -&- ( 2&, (18 -1+\*( )& ; ( :\*(1&+1 '%1+438 31&- )0\*)%&,5 )+, .&5410\*+ , A&% 310&,8 3(' &5, (3 \*+ -1( ; ( \* 62+A 60)< +. \*(0/ &, \*+ ' -0) (8 -1(' '41( \*( '\* (3 0\* ,+\* 2(' ' %0, 1B - '& ?100 <P0@ \$ D1&- -0, (22' ,+\* 022+A(3 &, \*4, , (2' +1) +, '\*1&)\*(3 '-0) (' 6( )04' ( +. =62+A!60)< +. \*(0/ .1+ / \*( ( 31&- -0, (22 +-( , &,5 '\$

2\$1E PRESSURE GAGES

A\$ P1+;3( 505(' & / / (3&0\*(27 3+A, '\*1(0/ +. (0)% \*(0/ 2&, ( &' +20\*+ , ;02; (8 6(.+1( 0,3 0.\*(1 (0)%

F\$E + 4&0.356603(%)0.71(2;S 1+ &, ) ??1

G\$ P1+;3( 2&D4&3 .822(3 505(' 0\* +4\*2(\* +. 022 -4 / - '\$

C\$ A) )410)7: G103( 2A8 1/2 -(1) ( , \*8 +, 022 505(' 0 (: ) (- \* G103( A8 +, ( -(1) ( , \* -(1 / & \*\* (3 +, 3&O-%105 / 0) \*40\*(3 505(' 8 2&D4&3 .822(3 505(' 8 0, 3 ) + / - +4, 3 505(' '\$

D\$ I, )243(:

1\$ R(3 ' (\* %0, 3' +, 505(' 2+)0\*(3 0\* 04\*+ / 0%) -1(' '41( 1(5420\*+1 ;02; ( +4\*2(\* '\$

2\$ N((32( ;02; ( +1 505( ) +) < 10\*(3 .+1 \*%( ' (1; &) (\$

\$ S7-%+, +, 022 '\* (0 / 505(' '\$

C\$ O; (12+03 '\*+ - +, 022 -1(' '41( 505(' '\$

E\$ E: ) (- \* A%(1( +\*(1A&' ( '%+A, +, \*( 310A&, 5' 8 -1(' '41( 10, 5(' '%022 6( 0' .+22+A':

SERVICE	RANGE
S*(0 / *+ 1B - ' & ?100 <P0@	0 *+ 0 - ' & ?0 *+ 200 <P0@
S*(0 / *+ BE - ' & ?COG <P0@	0 *+ 100 - ' & ?0 *+ G00 <P0@
S*(0 / 06+; ( BE - ' & ?COG <P0@	0 *+ 200 - ' & ?0 *+ 1B00 <P0@
C+, 3(, ' 0*( P4 / - D&' )%015(	0 *+ 100 - ' & ?0 *+ G00 <P0@
V0)44 / R(*41,	0 &, )%( ' HG 0 ! *+ 1B - ' & ?100 <P0 ;0)44 / *+ 100 <P0@

2&20 THERMOMETERS& PIPE OR TAN9 MOUNTED

A\$ T%(1 / + / (\* (1 2+)0\* &+, ' 01( '%+A, +, \*( 310A&, 5' '\$

B\$ T%(1 / + / (\* (1':

1\$ I, 34 '\*1&02 \*7- (8 ' (-01062( A(22 0, 3 '+) < (\*8 4, &+, )+, , ( )\*(3\$

2\$ R(3 1(03&, 5 / (1)417 )+ / 6&, 0\* &+, F0%1( , % ( &\*/C(2' &4' ' )02(8 E &, )%( ' ?220 / / @ 2+, 5\$

\$ C+11+ ' &+, 1( ' &' \*0, \* ) 0' ( A&\*% 5:0' ' +1 -20' \* &) .1+, \*\$

C\$ S\*10&5% \*+1 60) < .+1 / ( : ) (- \* %+( + 2+)0\*(3 / +1( \*%0, G .( (\* ?2100 / / @ 06+; ( .2++1 '%022 6( 0314' \*062( 0, 52(\$

B\$ W(22' ' &0(3 \*+ ' 4&\* -&- ( 3&0 / (\* (1 A&\*%+4\* 1( ' \*1&) \* &, 5 .2+A8 +1 -1+; &3( +; (1' &0(3 -&- ( 0\* A(22 2+)0\* &+, \$ S, 45 ' 2&3&, 5 .&\* 6(\*A( ( , '+) < (\* 0, 3 A(22\$

6\$ A) )410)7 '%022 6( +, ( -(1) ( , \*+ . ' )02( 10, 5(\$

G\$ 0 \*+ 00 3(5 F ?0 \*+ 1B0 3(5 C@ \$

2&21 PIPE HANGERS AND SUPPORTS

A\$ R(D4&1( / ( , '\*: MSS SP B8 0, 3 ASME B 1\$1\$

B\$ A - -2& ( ' \*+ 022 -&- &, 5 , +\* &, .0) \*+17!.061&)0\*(3 3&1( ) \*!641&(3 ' 7' \* ( / \$ A22 ' 7' \* ( / ' '%022 6( ) + / -2( \* (27 ' 4 - -+1\*(3\$ A110, 5( ' 4 - -+1\* ' ' + \*%0\* 022 2+03' 34( \*+ A( &5%\*8 \*%(1 / 02 ( : -0, ' &+, 8 ' ( &' / &) '%+ ) < ?&. 0 - -2&)062( @8 0, 3 -1( ' '41( 01( \*10, ' .(11(3 .1+ / \*%( ' 4 - -+1\* ' 7' \* ( / \*+ \*%( ' \*14) \*41(\$ T%( 3( ' &5, 0, 3 2+)0\* &+, +, ' 4 - -+1\* ' '%022 0\* 022 \* & / ( ' -1( ; ( , \* ( : ) ( ' & ; ( .+1) ( ' 8 / + / ( , \*' 8 0, 3 '\*1( ' ' ( ' .1+ / 6( &, 5 & / -+ ' (3 +, \*%( ( D4& - / ( , \*8 ' \*14) \*41(8 ' 4 - -+1\*(3 ' 7' \* ( / 8 0, 3 ' 4 - -+1\* '\$ H(0\*(3 ' 7' \* ( /

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D\$ D10A, 5':

1\$ T7- ('8 '8 2+)0\*+, '8 0,3 '-0), 5+. 022 %0,5(1' 0,3 '4-- +1\*\$

2\$ R+22(1 +1 '2&3(1 '4-- +1\*' .+1 022 %+1&0+, \*02 '\*'(0 / 0,3 )+, 3(, '0\*( -&-&, 5\$

\$ S-( )&02 '4-- +1\*' &, )243&, 5 0, )%+1'8 54&3(' 0,3 610)( '\$

C\$ I. (D4&- / (, \* 0,3 -&-&, 5 0110,5( / (, \* 3&..(1' .1+ / \*%0\* '%+A, +, \*( 310A&, 5'8 '4-- +1\* 2+)0\*+, ' 0,3 \*7-( ' '%022 6( 1(;&' (3 0\* ,+)+ '\* \*+



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'%022 6( '0 / ( 0' \*( 10)<(\*\$ #0- 0,3 64\*\* '\*1k-' / 0

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C\$ S(02 022 +- ( , 5 ' & , / 0 , % + 2 ( + 1 64 2 3 5 A 0 2 2 ' 0 . \* ( 1 1 ( / + ; 0 2 + . - & - & , 5 \$

D\$ U , 2 ( ' ' ' \* 0 \* ( 3 + \* % ( 1 A & ' ( 6 7 F 0 ) & 2 8 \* & ( ' O - ( 1 0 \* & + , ' M 0 , 0 5 ( / ( , \* 0 2 2 / 0 \* ( 1 & 0 2 0 , 3 ( D 4 & - / ( , \*  
1 ( / + ; ( 3 ' % 0 2 2 6 ( ) + / ( \* % ( - 1 + - ( 1 \* 7 + . \* % ( C + , \* 1 0 ) \* + 1 0 , 3 ' % 0 2 2 6 ( 1 ( / + ; ( 3 . 1 + / N + 1 \* % A ( ' \* ( 1 ,  
U , & ; ( 1 ' & \* 7 - 1 + - ( 1 \* 7 0 , 3 ' % 0 2 2 , + \* 6 ( ' \* + 1 ( 3 & , + - ( 1 0 \* & , 5 0 1 ( 0 ' \$

E\$ A 2 2 . 2 0 / ( ) 4 \* & , 5 ' % 0 2 2 6 ( - ( 1 . + 1 / ( 3 A & \* % 0 3 ( D 4 0 \* ( . & 1 ( - 1 + \* ( ) \* & + , . 0 ) & 2 8 \* & ( ' 0 ; 0 & 2 0 6 2 ( 0 ' 1 ( D 4 & 1 ( 3

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JOB # \_\_\_\_\_

FOR: \_\_\_\_\_  
ISSUED: 11/06/2018

9\$ S()41( 0, )%+1' A&#x27;+), )1(\* ( %14' \* 62+)<' \$

#\$ C+, , )(\* \*+ '\*(0 / 0,3)+,3(, '0\*( -&#x27;-&#x27;5 A%(1( &#x27;-0' (' %1+45% \*( 64&#x27;3&#x27;5 A022\$

M\$ #+++ '(!F&#x27;22 I, '420\*+&#x27;, I, '\*0220\*+&#x27;,:  
1\$ F+1 / &#x27; &#x27;420\*+&#x27;, \*1(, )% 67 (: )0;0\*+&#x27;, +1 67 &#x27;, '\*022&#x27;,5 317A022 ' &#x27;3( .+1 / ' \*+ ('\*062&#x27;' %\*(  
1(D4&#x27;1(3 % ( &#x27;5%\* 0,3 A&#x27;3%+ . \*( &#x27; &#x27;420\*+&#x27;,\$  
2\$ S4--++1\* -&#x27;-&#x27;5 A&#x27;3% -1+- (1 -&#x27;)\*%&#x27; ' (-010\*+&#x27;,8 0,3 )2(010, ) ( \*+ 60)<. &#x27;22 +1 ' &#x27;3( .+1 / ' 4' &#x27;,5  
\*( / -+1017 '4--++1\* &#x27;,5 3(;&#x27;)' %0\* )0, 6( 1( / +; (3 0.\*(1 60)<. &#x27;22&#x27;,5 A&#x27;3% &#x27;, '420\*+&#x27;,\$  
\$ P20( &#x27;, '420\*+&#x27;, 0,3 60)<. &#x27;22 0.\*(1 .&#x27;3( D402&#x27;7!)+, \*1+2 \*( ' \* &#x27;,5 %0' 6(, )+ / -2(\* 3 0,3  
1( '42\*' 0--1+; (3\$  
C\$ A--27 6&#x27;4 / 0' \* &#x27; )+0\* &#x27;,5 \*+ )016+ ,!'\*( 2 0, )%+1' 0,3 54&#x27;3( '\$ P+41 )+), )1(\* ( %14' \* 62+)<'<  
0,3 0, )%+1' \$  
B\$ W10- -&#x27;-&#x27;5 0\* (: -0, ' &#x27;+&#x27;, 2++-' 0,3 +.. (' \*' A&#x27;3% / &#x27;, (102!A++2 &#x27;, '420\*+&#x27;, +. %&#x27; &#x27; <, (' '  
0--1+-1&#x27;0\*( .+1 )02)420\*(3 (: -0, ' &#x27;+&#x27;, 0 / +4, \*\$  
6\$ P+41 2++' (!.&#x27;22 &#x27;, '420\*+&#x27;, \*+ 1(D4&#x27;1(3 3&#x27; / (, ' &#x27;+&#x27;, 05&#x27;0\* &#x27;,5 &#x27;, '420\*+&#x27;, \*+ (2&#x27; / &#x27;, 0\*( ;+&#x27;3'  
01+4,3 -&#x27;-&#x27;5\$  
G\$ R( / +; (\* ( / -+1017 %0,5(1' 0,3 '4--++1\*\$  
8\$ C+; (1 2++' (!.&#x27;22 &#x27;, '420\*+&#x27;, A&#x27;3% -+27(\*%72( ( ' %(( \* 0 / &#x27;, &#x27; / 4 / +. C / &#x27;2' ?0\$10 / / @ %&#x27; &#x27; <8  
0,3 ( / -\*7 2++' (!.&#x27;22 &#x27;, '420\*+&#x27;, 605' +, \*+-\$  
E\$ M0,40227 60)<. &#x27;22 A&#x27;3% 6 &#x27;, )% ?1B0 / / @ 2&#x27;. \*' +. )2(0, 60)<. &#x27;22\$ I. / ( )%0, &#x27;)02 )+ / -0)\* &#x27;+&#x27;, &#x27;'  
1(D4&#x27;1(38 / 0,40227 60)<. &#x27;22 A&#x27;3% 12 &#x27;, )% ? 00 / / @ 2&#x27;. \*' \$

N\$ I, '\*022 T10) (1 W&#x27;1( - (1 22 0000 =C+ / / +, W+1< R('42\*' .+1 P24 / 6&#x27;,5>\$

\$B DRAIN VA#VES AND VENT VA#VES

A\$ P1+; &#x27;3( 1!1/2 &#x27;, )% ?C0 / / @ / &#x27;, &#x27; / 4 / -&#x27;- ( ' &#x27;0( 310&#x27;, ;02; (' +, )+ ,3(, '0\*( 1(\*41, )011&#x27;(1 -&#x27;- (' 0\*  
022 2+A -+&#x27;, \*' &#x27;, / 0, %+2('\$ P1+; &#x27;3( 1 &#x27;, )% ?2B / / @ / &#x27;, &#x27; / 4 / 0&#x27;1 ; (, \* ;02; (' &#x27;, / 0, %+2(' 0\* 022  
&#x27;5% -+&#x27;, \*' &#x27;, )+ ,3(, '0\*( 1(\*41, )011&#x27;(1 -&#x27;-&#x27;5\$

\$6 PIPE SUPPORT INSTANTATION ?IN TRENCHES&#x27; TUNNE#&#x27;S&#x27; MANHO#&#x27;ES&#x27;

A\$ C++13&#x27;, 0\*( '4--++1\* 2+)0\*+&#x27;, ' -1&#x27;+1 \*+ (1)\* &#x27;+&#x27;, +. -&#x27;-&#x27;5\$ H0,5(1 -01\*' / 4' \* 6( / 01<(3 0\* %\*(  
.0)\*+17 A&#x27;3% 0 ,4 / 6(1&#x27;,5 '7'\*( / <(7(3 \*+ %0,5(1 207+4\* 310A&#x27;,5'\$ #07+4\* 310A&#x27;,5' / 4' \* 6(  
0;0&#x27;062( 0\* %\*( ' &#x27;\*( 341&#x27;,5 )+ , '\*14)\* &#x27;+&#x27;,\$

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D\$ S- ( ) 02 S4 -- +1\*':

1\$ S( ) 41( % + 10 + , \* 02 - & - ( ' A % ( 1 ( , ( ) ( ' 017 \* + - 1 ( ; ( , \* ; 610 \* & + , + 1 ( : ) ( ' ' A 07\$

2\$ W % ( 1 ( % 0 , 5 ( 1 ' ) 0 , , + \* 6 ( 03 ( D40 \* ( 27 ' ( ) 41 ( 3 0 ' ' - ( ) & & ( 38 / 0 < ( ' - ( ) & 02 - 1 + ; & ' & + , ' . + 1 % 0 , 5 & , 5 0 , 3 ' 4 - - + 1 \* & , 5 - & - ( 0 ' 0 - - 1 + ; ( 3 67 \* % ( C + , \* 10 ) \* & , 5 0 . & ) ( 1 1 1 ' R ( - 1 ( ' ( , \* 0 \* & ; ( \$

\$ D + , + \* 0 \* 0 ) % - & - ( ' 4 - - + 1 \* 8 % 0 , 5 ( 1 ' 8 ) 2 0 / - ' + 1 0 , ) % + 1 ' \* + ( D4 & - / ( , \* 4 , 2 ( ' ' - ( ) & & ( 3 . + 1 \* % 0 \* ( D4 & - / ( , \* + 1 4 , 2 ( ' ' \* % ( C + , \* 10 ) \* & , 5 0 . & ) ( 1 1 1 ' R ( - 1 ( ' ( , \* 0 \* & ; ( 5 & ; ( ' A 1 & \* \* ( , - ( 1 / & ' & + , \$

E\$ # + ) 0 \* ( ' - 1 & , 5 % 0 , 5 0 1 4 , & \* ' A & \* % & , 1 . + \* + ? 0 0 / / @ + . \* % ( - & - ( 0 \* 0 ) % / ( , \* 8 ( : ) ( - \* & , 2 + ) 0 \* & + , ' A % ( 1 ( ' - 1 & , 5 0 ' ' ( / 6 2 & ( ' & , \* ( 1 . ( 1 ( A & \* % - & - ( & , ' 4 2 0 \* & + , \$

F\$ S ( & / & ) B 1 0 ) ( ' 0 , 3 R ( ' \* 1 0 & , \* ' : D + , + \* & , ' 4 2 0 \* ( - & - & , 5 A & \* % & , 1 . + \* + ? 0 0 / / @ + . 3 ( ; & ) ( 4 , \* & 3 ( ; & ) ( % 0 ' 6 ( ( , & , ' - ( ) \* ( 3 6 7 C + , \* 10 ) \* & , 5 0 . & ) ( 1 1 1 ' R ( - 1 ( ' ( , \* 0 \* & ; ( \$ //

G\$ M & , & / 4 / C 2 ( 0 1 0 , ) ( ' & , T 4 , , ( 2 ' 0 , 3 T 1 ( , ) % ( ' :

1\$ F 2 + + 1 \* + 6 + \* \* + / + . - & - ( ' 4 - - + 1 \* 6 ( 0 / : 2 & , ) % ( ' ? B 0 / / @

2\$ F 2 + + 1 \* + 6 + \* \* + / + . - & - ( & , ' 4 2 0 \* & + , 1 0 ) < ( \* : 6 & , ) % ( ' ? 1 B 0 / / @

\$ W 0 2 2 \* + ' & 3 ( + . - & - ( & , ' 4 2 0 \* & + , 1 0 ) < ( \* : & , ) % ( ' ? G B / / @

C\$ C ( & 2 & , 5 \* + \* + - + . - & - ( & , ' 4 2 0 \* & + , 1 0 ) < ( \* : 1 & , ) % ? 2 B / / @

SG PAINTING EJPOSED STEE# SURFACES IN MANHO#ES8 TUNNE#S AND CONCRETE SHA##OW TRENCHES

A\$ F + 1 / 0 , % + 2 ( ' 0 , 3 A 0 2 < ! \* % 1 + 4 5 % \* 4 , , ( 2 ' 8 - 1 + ; & 3 ( ' 4 1 . 0 ) ( ) 2 ( 0 , & , 5 0 , 3 - 1 ( - 0 1 0 \* & + , 0 , 3 0 - - 2 7 - 1 & / ( ) + 0 \* + . 1 4 ' \* 1 ( ' & ' \* 0 , \* / ( \* 0 2 - 1 & / ( 1 \$

B\$ F + 1 ) , ) 1 ( \* ( ' % 0 2 + A \* 1 ( , ) % ( ' 8 - 1 + ; & 3 ( ' 4 1 . 0 ) ( ) 2 ( 0 , & , 5 0 , 3 - 1 ( - 0 1 0 \* & + , 8 0 - - 2 7 - 1 & / ( 1 0 , 3 . & , & ' % ) + 0 \* + . 0 & , ) ! 1 & ) % - 0 & , \* \$

\$8 DIRECT!BURIED SYSTEM INSTA###ATION

A\$ T % ( C + , \* 10 ) \* + 1 ' % 0 2 2 + ; ( 1 ' ( ( \* % ( 3 ( 2 & ; ( 1 8 ' \* + 1 ( 8 & , ' \* 0 2 2 0 , 3 \* ( ' \* \* % ( ' 7 ' \* ( / 0 ' - ( 1 / 0 , 4 . 0 ) \* 4 1 ( 1 1 ' 1 ( ) + / / ( , 3 0 \* & + , ' \$ A 2 2 A + 1 < ' % 0 2 2 6 ( & , ' \* 1 & \* 0 ) ) + 1 3 0 , ) ( A & \* % \* % ( 1 ( D 4 & 1 ( / ( , \* ' ' - ( ) & & ( 3 6 7 \* % ( / 0 , 4 . 0 ) \* 4 1 ( 1 \$ P 1 & , \* ( 3 & , ' \* 1 4 ) \* & + , ' / 4 \* 6 ( 0 ; 0 & 2 0 6 2 ( + , ' & \* ( - 1 & + 1 \* + 3 ( 2 & ; ( 1 7 + . ' 7 ' \* ( / ) + / - + , ( , \* \$ A , 7 ) % 0 , 5 ( ' 1 ( D 4 & 1 ( 3 \* + \* % ( 3 ( ' & 5 , 0 , 3 2 0 7 + 4 \* + . \* % ( ' 7 ' \* ( / 3 4 ( \* + & \* ( ) + , 3 & \* & + , ' / 4 \* 6 ( 0 - - 1 + ; ( 3 & , A 1 & \* & , 5 6 7 \* % ( C + , \* 10 ) \* & , 5 0 . & ) ( 1 1 1 ' R ( - 1 ( ' ( , \* 0 \* & ; ( \$ A 2 2 6 1 0 , ) % - & - & , 5 ) + , , ( ) \* & + , ' 8 ; 0 2 ; ( ' 0 , 3 3 1 & - \* 1 0 - ' / 4 \* 6 ( 2 + ) 0 \* ( 3 A & \* % & , / 0 , % + 2 ( ' \$

B\$ E : ) 0 ; 0 \* & + , 8 T 1 ( , ) % & , 5 8 0 , 3 B 0 ) < . & 2 2 & , 5 : P ( 1 + 1 / 0 2 2 ( : ) 0 ; 0 \* & + , 8 \* 1 ( , ) % & , 5 8 0 , 3 6 0 ) < . & 2 2 & , 5 0 ' 1 ( D 4 & 1 ( 3 6 7 \* % ( ' 7 ' \* ( / / 0 , 4 . 0 ) \* 4 1 ( 1 1 ' 3 ( ' & 5 , \$ B ( 0 ) % ' 0 , 3 + 1 0 , 7 ' 0 , 3 A & \* % 2 0 1 5 ( 0 / + 4 , \* ' + . ) % 2 + 1 & 3 ( ' & ' , + \* - ( 1 / & \* \* ( 3 \$ P 2 0 ) ( ' 7 ' \* ( / + , 0 6 & , ) % ? 1 B 0 / / @ \* % & < ' 0 , 3 6 ( 3 0 , 3 6 0 ) < . & 2 2 + , 0 2 2 ' & 3 ( ' A & \* % 6 & , ) % ? 1 B 0 / / @ \* % & < ' 0 , 3 0 ' / ( 0 ' 4 1 ( 3 . 1 + / + 4 \* & 3 ( \* % ( ) 0 1 1 & ( 1 - & - ( / & , ' 4 2 0 \* & + , \$ F + 4 , 3 0 \* & + , . + 1 ' 7 ' \* ( / / 4 \* 6 ( . & 1 / 0 , 3 ' \* 0 6 2 ( \$ F + 4 , 3 0 \* & + , 0 , 3 6 0 ) < . & 2 2 / 4 \* 6 ( . 1 ( ( . 1 + / 1 + ) < ' \$ C + , ) 1 ( \* ( 0 , ) % + 1 0 , 3 \* % 1 4 ' \* 6 2 + ) < ' / 4 \* 6 ( & , ' \* 0 2 2 ( 3 & , 4 , 3 & \* 4 1 6 ( 3 ( 0 1 \* % \$ B 0 ) < . & 2 2 & , 5 / 4 \* , + \* ) + / / ( , ) ( 4 , \* & 2 ( 2 ; 0 \* & + , ' % 0 ; ( 6 ( ( , ' 4 1 ; ( 7 ( 3 0 , 3 0 ) ) ( - \* ( 3 0 , 3 ' 7 ' \* ( / % 0 ' 6 ( ( , ' 0 \* & ' . 0 ) \* + 1 & 2 7 - 1 ( ' 4 1 ( \* ( ' \* ( 3 & , ) 2 4 3 & , 5 % 7 3 1 + \* 0 \* & ) \* ( ' \* & , 5 + . ) 0 1 1 & ( 1 - & - ( ' 0 , 3 0 & 1 \* ( ' \* & , 5 + . ) 0 ' & , 5 ' \$

C\$ M 0 & , \* 0 & , ) + , \* 0 , \* 2 + - ( + . ) 0 1 1 & ( 1 - & - ( ' 0 ' ' % + A , + 1 ' - ( ) & & ( 3 \$ P 1 & + 1 \* + 6 0 ) < . & 2 2 & , 5 + ; ( 1 \* % ( \* + - + . \* % ( ) 0 ' & , 5 8 6 4 \* 0 \* ( 1 1 ( / + ; 0 2 + . \* ( / - + 1 0 1 7 ' 4 - - + 1 \* 8 C + , \* 10 ) \* + 1 ' % 0 2 2 / ( 0 ' 4 1 ( 0 , 3 1 ( ) + 1 3 ( 2 ; 0 \* & + , ' + \* + - + . ) 0 ' & , 5 & , \* % ( \* 1 ( , ) % \$ E 2 ( ; 0 \* & + , ' ' % 0 2 2 6 ( \* 0 < ( , 0 \* ( ; ( 1 7 . & ( 2 3 1 + & , \* 8 1 / - + & , \* ' 0 2 + , 5 ( 0 ) % - & - ( ' ( ) \* & + , 8 0 , 3 0 3 \* + - ' + . ( 2 6 + A ' \$ T % ( ' ( / ( 0 ' 4 1 ( / ( , \* ' ' % 0 2 2 6 ( ) % ) < ( 3 0 5 0 & , ' \* ) + , \* 1 0 ) \* 3 1 0 A & , 5 ' 0 , 3 ' % 0 2 2 ) + . & 1 / \* % 0 \* \* % ( ) + , 3 4 \* ' 7 ' \* ( / % 0 ' 6 ( ( , & , ' \* 0 2 2 ( 3 \* + \* % ( 2 ( ; 0 \* & + , ' )

'%+A, +, \*( )+, \*10)\* 310A&, 5' 4, 2(' ' 0 - -1+; (3 67 \*( C+, \*10)\*&, 5 O..&)(111' R(-1(' (, \*0\*&; (\$ S2+- ( '%022 6( 4, &. +1/ A&\*&, 0\$1 - (1) (, \*\$ M(0'41( / (, \*' '%022 6( 1( )+13(3 67 \*( C+, \*10)\*+18 &, )243(3 &, \*( 3&1( ) \* 641&(3 '7'\*( / / 0, 4.0)\*41(1 1(-1(' (, \*0\*&; (111' 30&27 1(-+1\*8 0, 3 5&; (, \*+ \*( C+, \*10)\*&, 5 O..&)(111' R(-1(' (, \*0\*&; ( -1&+1 \*+ )+; (1&, 5 \*( \*+- +. \*( )0'&, 5 A&\*& 60)<. &22\$

D\$ P1+; &3( )0%+3&) -1+\*( )\*&+, .+1 022 \*( (2 )0'&, 5 '7'\*( / ' 0, 3 022 641&(3 (: -+ ' (3 / (\*0\$ P1+; &3( 3&(2( )\*1&) -&- ( .20, 5(' 0, 3 4, &+, ' 0, 3 &' +20\*&+, 3(; &)( ' 0\* 022 -+&, \*' , ( )(' '017\$ P1+; &3( \*(' ' \*0\*&+, ' 0\* 5103( +, (0)% ' ( )\*&+, +. \*( -&-&, 5 '7'\*( / \$1'+20\*&+, .20, 5(' 0, 3 4, &+, ' '%022 6( 10\*(3 .+1 \*( )011&(1 -&- ( ' (1; &)( \* ( / - (10\*41( 0, 3 -1(' '41(\$

E\$ R( / +; ( 022 3&1\*8 ' )02(8 0, 3 +\*(1 .+1(&5, / 0\*\* (1 .1+ / &, ' &3( \*( -&-&, 5 67 4' ( +. 0 -&- ( ' A06 +1 -&- ( =-&5> 6.(+1( )+, , ( )\*&, 5 -&- ( ' ( )\*&+, ' 8 ; 02; ( ' 8 +1 .&\*&, 5' \$

F\$ S( )\*&+, ' +. '7'\*( / \*%0\* %0; ( 6( (, .4227 +1 -01\*&0227 '46 / (15(3 &, A0\*(1 / 4'\* 6( 1(-20)(3\$ M+&' \*41( )+, \* (, \* +. &, '420\*&+, 341&, 5 &, ' \*0220\*&+, ' %022 , +\*( : ) ( (3 .&; ( - (1) (, \* 67 A(&5%\*\$

G\$ A\*(0)% 0'&, 5 \*(1 / &, 0\*&+, ?(, 3 -20\*( @ &, 64&23&, 5' 0, 3 / 0, %+2(' 8 -245 \*( )0'&, 5 310&, +- ( , &, 5' A&\*& 610' ' -245' 0, 3 (: \*(, 3 1 &, )% -&- ( ' &0( 502; 0, &0(3 ; (, \* -&- ( ' ?ASTM AB @ .1+ / \*( )0'&, 5 ; (, \*' %1+45% \*( \*+- ' +. \*( / 0, %+2(' +1 1 .+\*+ ? 00 / / @ 06+; ( \*( )+, 34&\* &, 64&23&, 5' \$ T(1 / &, 0\*( \*( +4\* ' &3( ; (, \*' &, 18013(51( ( 6(, 3' \$

H\$ P1+; &3( 1(-+1\*' \*+ \*( C+, \*10)\*&, 5 O..&)(111' R(-1(' (, \*0\*&; ( %0\* &, )243(:

1\$ D0&27 A1&\*(, 1(-+1\*: P1(-01(3 30&27 0, 3 ' &5, (3 67 \*( C+, \*10)\*+1\$ S46 / &' \*( +1&5&, 02 1(-+1\* \*+ \*( C+, \*10)\*&, 5 O..&)(111' R(-1(' (, \*0\*&; ( +, \*( ' 0 / ( 307 &\* &' -1(-01(3\$ P1+; &3( +, ( ' ( +. .&(23 -&) \*41( ' +. A+1< 30&27\$

2\$ R(-+1\* C+, \* (, \*': S\*0\*( A% (\* (1 +1 , +\* \*( )+, 3&\* &+, 0, 3 D40&27 \*+ . \*( / 0\*(1&02' 4' (3 0, 3 \*( 3(2&; (178 ' \*+105(8 &, ' \*0220\*&+, 0, 3 \*( ' &5 +. \*( '7'\*( / 01( &, 0))+130, ) ( A&\*& \*( / 0, 4.0)\*41(111' 1( )+ / / (, 30\*&+, ' 8 )%0, 5( ' \*+ 310A&, 5' 0, 3 '- ( )&. &)0\*&+, ' 8 0, 7)+11( )\*&; ( 0)\*&+, %0\* A0' \*0<(, +. \*( '7'\*( / 8 &3(, \*.7 0, 7)+, 3&\* &+, ' %0\* )+423 1('42\* &, 0, 4, ' 0\*&' .0)\*+17 &, ' \*0220\*&+, \$

\$ R(-+1\* C(1&. &)0\*&+, : D0&27 1(-+1\*' 01( \*+ 6( 1(; &(A(38 ' &5, (3 0, 3 '(02(3 67 \*( P1+.( ' &+ , 02 E, 5&, ( (1 1(' -+ , ' &62( .+1 \*( '7'\*( / &, ' \*0220\*&+, \$

C\$ R(-+1\* S46 / &' \*02' 0, 3 S\*+- 013(1: D0&27 1(-+1\*' '%022 6( '46 / &' \*(3 A&\*& \*( -07 / (, \* 1(D4(' \*\$ A22 A+1< / 4\* ' \*+- &. 30&27 1(-+1\*' 01( , +\* .41, &' % (3 0, 3 1(D4(' \*' .+1 -07 / (, \* '%022 6( 3(, &(302, 1.7152(&)4.71394( , )0.71320(8, 301(



NORTHWESTERN UNIVERSITY

PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

§10 INSTANTATION ! SAFETY VA#VES

A\$ V02; ( ' / 4 '\* 6 ( 4-15%\* 0,3 +1& ( , \*( 3 '+ %0\* 2&.\*&, 5 2( ; (1' 01( 0) ) ( ' '62( .1+ / , (01( '\* A02<A07\$

B\$ P1+; &3( ' - ( )&02 .2( :&62( )+ , , ( )\*+1 + , (0)% '0.( \*7 ;02; ( \*%0\* &' 3( ' &5, (3 \*+ 0; +&3 62+A!60)< +.  
'\*(0 / &, + \*% ( \*4 , , (2 +1 / 0, %&2( \$ S2&- l+&, \* \*+ 6( 0110, 5(3 \*+ -1( ; ( , \* ; ( , \* 2&, ( .1+ / & / -+ ' &, 5 0, 7  
'\*10&, + , '0.( \*7 ;02; ( 0, 3 \*+ -1( ; ( , \* / +&'41( 0) ) 4 / 420\*&+ , &, '0.( \*7 ;02; ( \$ S4-- +1\* ; ( , \* 2&, (



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PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

1\$ F2(:162( )+, , ( )+1'

1\$ B022 I+1, \*' (:)(- \* -1-1, 5 6(\*A((, I+1, \*'

6\$ I, '\*0220\*1+, +. 1, '420\*1+, :

0\$ P1(''41( T('\*': C+ / -2(\* 022 -1(''41( \*('\*' 6(.+1( 1, '\*022, 5\$

6\$ I, '420\*1+, / O\*(1102: N(A8)2(0,8 317 0,3 '\*+1(3

NORTHWESTERN UNIVERSITY

PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

B\$ W(23(1 H402&.i)0\*!+, ': A22 A(23(1' '%022 6( D402&.i(3 0' -(1 ASME B 1\$1 0, 3 AWS B2\$1!B2\$1M!  
BMG\$

C\$ F&(23 6(; (2' 0, 3 '%+- 6(; (2': D+, ( 67 / (%)0, i)02 / (0, ' +1 67 .20 / ( )4\*\*i, 5\$ W%(1( 6(; (2&, 5 i'  
3+, ( 67 .20 / ( )4\*\*i, 58 '41.0)(' '%022 6( \*%+1+45%27

NORTHWESTERN UNIVERSITY  
PROJECT NAME \_\_\_\_\_  
JOB # \_\_\_\_\_

FOR: \_\_\_\_\_  
ISSUED: 11/06/2018

§18 IDENTIFICATION SIGNS

A\$ V02; (': P1+; 3( 20 / 5, 0\*(3 -20' \*5) ' 5, ' 8 A5\*% ( , 510; (3 2(\*\*(15 , +\* 2(' ' \*%0, /16 5,) % ?B / / @  
%5%8 +, 022 5'+20\*5, 5 ;02; (' +, '\* (0 / 0, 3)+, 3(, ' 0\*( 1(\*41, ' 7'\*( / 8 53( , \* .75, 5 64235, 5 +1 01(0  
' (1; (3\$ A\*\*0)% \*+ \*( ;02; (' A5\*%) +11+' 5+, !1( ' 5' \*0, \* )%05, '\$

B\$ P5- (': #06(2 ' (1; 5) ( +. 022 -5- ( ' 5, / 0, % +2( ' 0, 3 A02<!%14 \*4, , (2' \$

§1E FIE#D HUA#ITY CONTRO#

A\$ D( / +, '\*10\*( 2(0<!5%\*, (' ' +. 022 -5- 5 ' 7'\*( / ' 67 - (1.+1 / 5, 5 %731+' \*0\*5) 0, 3 +- (10\*5+, 02\*( ' \*' \$  
A22 206+18 / 0\*(1502 0, 3 \*( ' \* 5, '\*14 / (, '\* / 4' \* 6( .41, 5' % (3 67 \*( C+, \*10)\*+1\$ A22 5, '\*14 / (, '\* / 4' \*

NORTHWESTERN UNIVERSITY

PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

C\$ E0%)0'&,5.&(23 l+&, \* '%022 6( \*( '(3 .+1 2(0<' 67 / (0, ' +. '+0- '+24\*&+, +1 (D4&;02( ,\*\$

G\$ NACE10))1(3&\*(3 )+11+'&+, ' - (&02&'\* '%022 \*( '\* )0\*%+3&) -1+\*( )\*&+, '7'\*( / ' 0,3 3( / +, '\*10\*(  
-1+- (1 +- (10\*&+, 0,3 -1+\*( )\*&+, &, 0))+130, ) ( A&\*&% \*( 1( )+ / / ( ,30\*&+, ' 0,3 )1&\*(1&0 &, NACE  
SP016E\$

H\$ D(.&)&( , )&(' 3&' )+; (1(3 '%022 6( )+11( )\*(3 0\* \*( C+, \*10)\*+1f' (: - ( , ' (8 \*+ '0\*&' .0)\*&+, +.  
C+, \*10)\*&, 5 O..&)(1' R(-1( ' ( , \*0\*&; (\$ MOI+1 3(.&)&( , )&(' +1 .0&241( \*+ )+11( )\* 3(.&)&( , )&(' 8 \*+ \*(  
'0\*&' .0)\*&+, +. \*( C+, \*10)\*&, 5 O..&)(1' R(-1( ' ( , \*0\*&; (8 / 07 6( )+, ' &3(1(3 )04' ( .+1 1(1( )\*&, 5  
\*( ( , \*&1( &, '\*0220\*&+, \$

SITE CONDITION	GENERAL CONDITIONS OF GROUND WATER DURING THE WETTEST PERIOD OF THE YEAR	SURFACE WATER ACCUMULATION RAINFALL/ IRRIGATION	TRENCH CONSTRUCTION
A\$ F ( 510, (3 / - (1;4' +1 ' / - (1;4' 0,3 ) +01' ( 510, (3 / - (1;4'	W0*(1*062( 5(, (10227 1 .++ ? 00 / / 6(2+A 2+A ('* -+ , * +. A0*(1 ( , *17 ?S( ( N+*( B A% , +* / +1( %0, 2BR +. *( 2( , 5% +. *( -1+--' (3) +, )1(* *1( , )% '7'*( / '%+A, 5 A0*(1 A% , 1 .++ ? 00 / / +. *( 2+A ('* -+ , * +. A0*(1 ( , *17\$	B 7(01 ! G 307 10, .022 (D402 *+ +1 2(' ' %0, 10 , )%( ' ?2B0 / / \$ ?S( ( N+*( 2	C+, , 4+4' A02 0, 3 6+**+ / \$
B\$ C+01' ( 510, (3 ' / - (1;4' 0,3 - (1;4' ?S( ( N+*( 2	S0 / ( 0' .+1 A\$ 06+; (\$	B 7(01 ! G 307 10, .022 (D402 *+ +1 2(' ' %0, 10 , )%( ' ?2B0 / / \$	S0 / ( 0' .+1 A\$ 06+; (\$
	W0*(1*062( 5(, (10227 2 .( (* ?600 / / +1 / +1( 6(2+A -+ , * + . A0*(1 ( , *17 A% , +* / +1( % 0, 10R +. *( 2( , 5% +. *1( , )% '7'*( / '%+A, 5 A0*(1 A% , 2 . ( (* ?600 / / 64* , +* )2+ ' (1 %0, 1 .++ ? 00 / / *+2+A ('* -+ , * +. A0*(1 ( , *17\$	B 7(01 ! G 307 10, .022 (D402 *+ +1 2(' ' %0, 8 , )%( ' ?200 / / \$ ?S( ( N+*( 2	C+, , 4+4' A022 +- ( , 5' / 07 6( -1+; 3(3 , *1( , )% 6+**+ / *+ -1+; 3( 310, 05(\$
C\$ SA (22, 5 '+2' ?S( ( N+*( @	S0 / ( 0' .+1 A\$ 06+; (\$	S0 / ( 0' .+1 A\$ 06+; (\$	S0 / ( 0' .+1 A\$ 06+; (\$ -24' 3( '5, +. 1+ , * ' -0) , 5 0, 3 1+ , * 3(*02' *+ 0)) + / +30*( / +; ( / ( , \$

NOTES:

- 1\$ S%022+A) +, )1(\* (\*1( , )% '7'\*( / '%022 , +\* 6( 4' (3 &. 0, 7) +, 3&+ , ' 3( ., (3 67 \*( ' ( ) 1&\* (1& 01( ( : ) (3(3\$
- 2\$ A' '%+A, &, U\$ S\$ W(0\*(1 B41(04 ?USWB@ T( )%, &) 02 P0- (1 C0 0, 3 )+, .1 / (3 A&\*2+) 02 30\*0 0, 3 2+) 02 A(0\*(1 -0\*\* (1, ' \$ SA(22, 5 '+2' 01( / 0\*(1&02' A&\*% %&5% 'A(22 -+\*( , \*&02 A%( , '461( )\*(3 \*+ 0, &, )1(0' ( &, / +&'41( )+, \*( , \*\$
- C\$ P1( )&-&\*0&+, 10\*( ' .+1 0' - ( )&. &) ' &\*( '%+423 6( 4' (3 \*+ 3( ' &5, 310, 05( '7'\*( / ' 0, 3 ' (2( ) \* '4 / - -4 / - ' \$
- B\$ #+A ('\* -+ , \* +. A0\*(1 ( , \*17 &' 3( ., (3 0' \*( ( 1+

NORTHWESTERN UNIVERSITY

PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 11/06/2018

B ! B03	$1\$ T\% ( A0^*(1^*062( \&' (: - ( )^*(3^* + 6( +))0' \&+, 0227 06+; ( \% ( 6+^{**}+ / +. \% ( '7'^*( / 0, 3 '41.0) ( A0^*(1 \&' (: - ( )^*(3^* + 0))4 / 420^*( 0, 3 1( / 0\&, .+1 '\%+1^* - (1\&+3' ?+1, +^* 0^* 022\& \&, \% ( '+\&2 '411+4, 3\&, 5 \% ( '7'^*( / 8 +1$
	$2\$ T\% ( A0^*(1^*062( \&' (: - ( )^*(3, (; (1^* + 6( 06+; ( \% ( 6+^{**}+ / +. \% ( '7'^*( / 64^* '41.0) ( A0^*(1 \&' (: - ( )^*(3^* + 0))4 / 420^*( 0, 3 1( / 0\&, .+1 2+, 5 - (1\&+3' \&, \% ( '+\&2 '411+4, 3\&, 5 \% ( '7'^*( / \$$
C ! M+3(10*(	$T\% ( A0^*(1^*062( \&' (: - ( )^*(3, (; (1^* + 6( 06+; ( \% ( 6+^{**}+ / +. \% ( '7'^*( / 64^* '41.0) ( A0^*(1 \&' (: - ( )^*(3^* + 0))4 / 420^*( 0, 3 1( / 0\&, .+1 '\%+1^* - (1\&+3' \&, \% ( '+\&2 '411+4, 3\&, 5 \% ( '7'^*( / \$$
D ! M&23	$T\% ( A0^*(1^*062( \&' (: - ( )^*(3, (; (1^* + 6( 06+; ( \% ( 6+^{**}+ / +. \% ( '7'^*( / 0, 3 '41.0) ( A0^*(1 \&' , +^* (: - ( )^*(3^* + 0))4 / 420^*( +1 1( / 0\&, \&, \% ( '+\&2 '411+4, 3\&, 5 \% ( '7'^*( / \$$