

## FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by Heat Exchanger Design, Inc., 901 E. Beecher Street, Indianapolis, Indiana, 46203  
(Name and address of Manufacturer)

2. Manufactured for MEG ENERGY CORP., Christina Lake Regional Project Phase 3A, AFE#A-1005-C, 11th Floor, 520 3 Avenue S.W., Calgary, Alberta, T2P0R3, CANADA  
(Name and address of Purchaser)

3. Location of installation Unknown  
(Name and address)

4. Type Horizontal Separated Head Hairpin Heat Exchanger 4565A2  
(Horizontal, vertical, or sphere) (Tank, separator, jkt. vessel, heat exch., etc.) (Manufacturer's serial number)

W9513.2 4565A Rev.5 4314 2017  
(CRN) (Drawing number) (National Board number) (Year built)

5. ASME Code, Section VIII, Div. 1 2010/ A11 N/A N/A  
[Edition and Addenda, if applicable (date)] (Code Case Number) [Special Service per UG-120(d)]

Items 6-11 incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multichamber vessels.

6. Shell: (a) Number of course(s) 2 (b) Overall length 24' 6"

| Course(s) |            |           | Material            |  | Thickness |       | Long. Joint (Cat. A) |                  |      | Circum. Joint (Cat. A, B, & C) |                  |      | Heat Treatment |      |
|-----------|------------|-----------|---------------------|--|-----------|-------|----------------------|------------------|------|--------------------------------|------------------|------|----------------|------|
| No.       | Diameter   | Length    | Spec./Grade or Type |  | Nom.      | Corr. | Type                 | Full, Spot, None | Eff. | Type                           | Full, Spot, None | Eff. | Temp.          | Time |
| 2         | 17.25" ID  | 24' 6"    | SA106-B             |  | 0.375     | 0.125 | S                    | N/A              | 100% | N/A                            | N/A              | N/A  | N/A            | N/A  |
| 2         | 17.063" OD | 0' 6.179" | SA106-B             |  | 0.25      | 0.125 | S                    | N/A              | 100% | N/A                            | N/A              | N/A  | N/A            | N/A  |

| Body Flanges on Shells |      |        |         |            |             |           |              |          |                            |  |                               |  |                      |                 |
|------------------------|------|--------|---------|------------|-------------|-----------|--------------|----------|----------------------------|--|-------------------------------|--|----------------------|-----------------|
| No.                    | Type | ID     | OD      | Flange Thk | Min Hub Thk | Material  | How Attached | Location | Bolting                    |  |                               |  |                      |                 |
|                        |      |        |         |            |             |           |              |          | Num & Size                 |  | Bolting Material              |  | Washer (OD, ID, thk) | Washer Material |
| 2                      | WN   | 17.25" | 20.5"   | 2          | N/A         | SA516-70N | UW-13.2(n)   | FRONT    | 24 / 24 - 0.75"-10 x 5" Lg |  | SA193-B7 studs/ SA194-2H nuts |  | 1.5, 0.813, 0.134    | Wrought Steel   |
| 1                      | WN   | 17.25" | 37.013" | 2.438      | N/A         | SA516-70N | UW-13.2(m)   | REAR     | N/A                        |  | N/A                           |  | N/A                  | N/A             |

7. Heads: (a) SA516-70N (b) N/A  
(Material spec. number, grade or type) (H.T. - time and temp.) (Material spec. number, grade or type) (H.T. - time and temp.)

|     | Location (Top, Bottom, Ends) | Thickness |       | Radius |         | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure |         | Category A |                  |      |
|-----|------------------------------|-----------|-------|--------|---------|------------------|--------------------|----------------------|---------------|------------------|---------|------------|------------------|------|
|     |                              | Min.      | Corr. | Crown  | Knuckle |                  |                    |                      |               | Convex           | Concave | Type       | Full, Spot, None | Eff. |
| (a) | REAR                         | 0.34      | 0.125 | N/A    | N/A     | 2:1              | N/A                | N/A                  | N/A           | X                | X       | 1          | Full             | 100% |
| (b) | N/A                          | N/A       | N/A   | N/A    | N/A     | N/A              | N/A                | N/A                  | N/A           |                  |         | N/A        | N/A              | N/A  |

| Body Flanges on Heads |          |      |         |         |            |             |           |              |                            |  |                               |  |                      |                 |
|-----------------------|----------|------|---------|---------|------------|-------------|-----------|--------------|----------------------------|--|-------------------------------|--|----------------------|-----------------|
|                       | Location | Type | ID      | OD      | Flange Thk | Min Hub Thk | Material  | How Attached | Bolting                    |  |                               |  |                      |                 |
|                       |          |      |         |         |            |             |           |              | Num & Size                 |  | Bolting Material              |  | Washer (OD, ID, thk) | Washer Material |
| (a)                   | REAR     | WN   | 29.369" | 37.013" | 3.188      | N/A         | SA516-70N | UW-13.2(m)   | 36 / 64 - 0.75"-10 x 8" Lg |  | SA193-B7 studs/ SA194-2H nuts |  | 1.5, 0.813, 0.134    | Wrought Steel   |

8. Type of jacket N/A Jacket closure N/A  
(Describe as ogee & weld, bar, etc.)

If bar, give dimensions; if bolted, describe or sketch N/A

9. MAWP 218 psi F.V. at max. temp. 353 °F 353 °F Min. design metal temp. -20 °F at 218 / F.V.  
(Internal) (External) (Internal) (External)

10. Impact test No, studs & nuts exempt per Fig.UCS-66 and remaining items per UG-20(f). at test temperature of N/A  
[Indicate yes or no and the component(s) impact tested]

11. Hydro., pneu., or comb. test pressure Hydro. at 283 psi Proof test N/A

Items 12 and 13 to be completed for tube sections.

12. Tubesheet SA240-316/L 17.063" 1.688 N/A Bolted  
[Stationary (material spec. no.)] [Diameter (subject to press.)] (Nominal thickness) (Corr. allow.) Attachment (welded or bolted)

N/A N/A N/A N/A N/A  
[Floating (material spec. no.)] (Diameter) (Nominal thickness) (Corr. allow.) (Attachment)

13. Tubes SA213-TP316/L 0.75 0.065 230 U  
(Material spec. no., grade or type) (O. D.) (Nominal thickness) (Number) [Type (Straight or U)]

Items 14-18 incl. to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14. Shell: (a) No. of course(s) N/A (b) Overall length N/A

| Course(s) |            |            | Material            |  | Thickness  |            | Long. Joint (Cat. A) |                  |            | Circum. Joint (Cat. A, B, & C) |                  |            | Heat Treatment |            |
|-----------|------------|------------|---------------------|--|------------|------------|----------------------|------------------|------------|--------------------------------|------------------|------------|----------------|------------|
| No.       | Diameter   | Length     | Spec./Grade or Type |  | Nom.       | Corr.      | Type                 | Full, Spot, None | Eff.       | Type                           | Full, Spot, None | Eff.       | Temp.          | Time       |
|           | <b>N/A</b> | <b>N/A</b> | <b>N/A</b>          |  | <b>N/A</b> | <b>N/A</b> | <b>N/A</b>           | <b>N/A</b>       | <b>N/A</b> | <b>N/A</b>                     | <b>N/A</b>       | <b>N/A</b> | <b>N/A</b>     | <b>N/A</b> |

| Body Flanges on Shells |            |            |            |            |             |            |              |            |            |                  |                      |                 |            |
|------------------------|------------|------------|------------|------------|-------------|------------|--------------|------------|------------|------------------|----------------------|-----------------|------------|
| No.                    | Type       | ID         | OD         | Flange Thk | Min Hub Thk | Material   | How Attached | Location   | Bolting    |                  |                      |                 |            |
|                        |            |            |            |            |             |            |              |            | Num & Size | Bolting Material | Washer (OD, ID, thk) | Washer Material |            |
| <b>N/A</b>             | <b>N/A</b> | <b>N/A</b> | <b>N/A</b> | <b>N/A</b> | <b>N/A</b>  | <b>N/A</b> | <b>N/A</b>   | <b>N/A</b> | <b>N/A</b> | <b>N/A</b>       | <b>N/A</b>           | <b>N/A</b>      | <b>N/A</b> |

15. Heads: (a) SA240-316/L (b) SA240-316/L  
(Material spec. number, grade or type) (H.T. - time and temp.) (Material spec. number, grade or type) (H.T. - time and temp.)

|            | Location (Top, Bottom, Ends) | Thickness   |            | Radius     |            | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure |          | Category A |                  |            |
|------------|------------------------------|-------------|------------|------------|------------|------------------|--------------------|----------------------|---------------|------------------|----------|------------|------------------|------------|
|            |                              | Min.        | Corr.      | Crown      | Knuckle    |                  |                    |                      |               | Convex           | Concave  | Type       | Full, Spot, None | Eff.       |
| <b>(a)</b> | <b>FRONT</b>                 | <b>0.29</b> | <b>N/A</b> | <b>N/A</b> | <b>N/A</b> | <b>2:1</b>       | <b>N/A</b>         | <b>N/A</b>           | <b>N/A</b>    | <b>X</b>         | <b>X</b> | <b>N/A</b> | <b>N/A</b>       | <b>N/A</b> |
| <b>(b)</b> | <b>FRONT</b>                 | <b>0.29</b> | <b>N/A</b> | <b>N/A</b> | <b>N/A</b> | <b>2:1</b>       | <b>N/A</b>         | <b>N/A</b>           | <b>N/A</b>    | <b>X</b>         | <b>X</b> | <b>N/A</b> | <b>N/A</b>       | <b>N/A</b> |

| Body Flanges on Heads |              |           |                |              |              |             |                    |                   |                                     |                                      |                          |                      |  |
|-----------------------|--------------|-----------|----------------|--------------|--------------|-------------|--------------------|-------------------|-------------------------------------|--------------------------------------|--------------------------|----------------------|--|
|                       | Location     | Type      | ID             | OD           | Flange Thk   | Min Hub Thk | Material           | How Attached      | Bolting                             |                                      |                          |                      |  |
|                       |              |           |                |              |              |             |                    |                   | Num & Size                          | Bolting Material                     | Washer (OD, ID, thk)     | Washer Material      |  |
| <b>(a)</b>            | <b>FRONT</b> | <b>WN</b> | <b>15.375"</b> | <b>20.5"</b> | <b>1.688</b> | <b>N/A</b>  | <b>SA240-316/L</b> | <b>UW-13.2(m)</b> | <b>12 / 12 - 0.75"-10 x 5.5" Lg</b> | <b>SA193-B7 studs/ SA194-2H nuts</b> | <b>1.5, 0.813, 0.134</b> | <b>Wrought Steel</b> |  |
| <b>(b)</b>            | <b>FRONT</b> | <b>WN</b> | <b>15.375"</b> | <b>20.5"</b> | <b>1.688</b> | <b>N/A</b>  | <b>SA240-316/L</b> | <b>UW-13.2(m)</b> | <b>12 / 12 - 0.75"-10 x 5.5" Lg</b> | <b>SA193-B7 studs/ SA194-2H nuts</b> | <b>1.5, 0.813, 0.134</b> | <b>Wrought Steel</b> |  |

16. MAWP 168 psi F.V. at max. temp. 353 °F 353 °F Min. design metal temp. -20 °F at 168 / F.V.  
(Internal) (External) (Internal) (External)17. Impact test No, studs & nuts exempt per Fig.UCS-66 and remaining items per UHA-51(d)(1). at test temperature of N/A  
[Indicate yes or no and the component(s) impact tested]18. Hydro., pneu., or comb. test pressure Hydro. at 218 psi Proof test N/A

19. Nozzles, inspection, and safety valve openings:

| Purpose (Inlet, Outlet, Drain, etc.) | No.      | Diameter or Size | Type                | Material                |                     | Nozzle Thickness |              | Reinforcement Material | Attachment Details |                   | Location (Insp. Open.) |
|--------------------------------------|----------|------------------|---------------------|-------------------------|---------------------|------------------|--------------|------------------------|--------------------|-------------------|------------------------|
|                                      |          |                  |                     | Nozzle                  | Flange              | Nom.             | Corr.        |                        | Nozzle             | Flange            |                        |
| <b>Shell Inlet</b>                   | <b>1</b> | <b>6</b>         | <b>CL.300 RFWN</b>  | <b>SA106-B</b>          | <b>SA105</b>        | <b>0.280</b>     | <b>0.125</b> |                        | <b>UW-16.1(c)</b>  | <b>Fig.2-4(6)</b> | <b>Bottom</b>          |
| <b>Shell Outlet</b>                  | <b>1</b> | <b>6</b>         | <b>CL.300 RFWN</b>  | <b>SA106-B</b>          | <b>SA105</b>        | <b>0.280</b>     | <b>0.125</b> |                        | <b>UW-16.1(c)</b>  | <b>Fig.2-4(6)</b> | <b>Top</b>             |
| <b>Tube Inlet</b>                    | <b>1</b> | <b>8</b>         | <b>CL.150 RFWN</b>  | <b>SA312-TPWP316/LW</b> | <b>SA182-F316/L</b> | <b>0.322</b>     |              |                        | <b>UW-16.1(a)</b>  | <b>Fig.2-4(6)</b> | <b>End</b>             |
| <b>Tube Outlet</b>                   | <b>1</b> | <b>8</b>         | <b>CL.150 RFWN</b>  | <b>SA403-WP316/LW</b>   | <b>SA182-F316/L</b> | <b>0.322</b>     |              |                        | <b>UW-16.1(a)</b>  | <b>Fig.2-4(6)</b> | <b>End</b>             |
| <b>Shell Vent</b>                    | <b>1</b> | <b>1</b>         | <b>CL.300 RFLWN</b> | <b>SA105</b>            | <b>SA105</b>        | <b>0.5625</b>    | <b>0.125</b> |                        | <b>UW-16.1(c)</b>  | <b>Integral</b>   | <b>Top</b>             |
| <b>Tube Vent/Drain</b>               | <b>2</b> | <b>1</b>         | <b>CL.150 RFWN</b>  | <b>SA312-TPWP316/LW</b> | <b>SA182-F316/L</b> | <b>0.109</b>     |              |                        | <b>UW-16.1(a)</b>  | <b>Fig.2-4(6)</b> | <b>Top/Bottom</b>      |

20. Supports: Skirt No Lugs N/A Legs N/A Others Saddle supports Attached Welded to shell bottom  
(Yes or no) (Number) (Number) (Describe) (Where and how)

21. Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report (list the name of part, item number, Manufacturer's name, and identifying number):

N/A

22. Remarks

1) Relief valving to be supplied in customers piping. 2) Shell overall length listed for each leg, parallel legs w/common cover. 3) The rear shell body flange is obround shaped with (2) 17.25" dia. holes. Diameter reported derived from perimeter. 4) Shell cover constructed from a 38" OD 2:1 elliptical head described on line 7. 5) Skirted tubesheets consist of material reported on line 12 and 17.063" OD courses reported on line 6. Reported skirt thickness refers to thinnest machined area. 6) Tube inlet and outlet nozzles attached to channel heads and are bolted to skirted tubesheets as described on line 15. 7) No radiography performed on shell nozzles, 100% radiography on tube nozzles, 100% Eff. for all.

## CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. U Certificate of Authorization Number 23740 Expires September 27, 2017

Date 05/10/2017 Name Heat Exchanger Design, Inc. Signed *David A. Hester*  
(Manufacturer) (Representative)

## CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by

OneCIS Insurance Company, of Lynn, MA

have inspected the pressure vessel described in this Manufacturer's Data Report on May 10, 2017, and state that,

to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 05/10/2017 Signed *M. G. MacLeod* Commissions: 10006, OH428, KY955, IN1418  
(Authorized Inspector) [National Board (incl. endorsements)]

## CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the statements made in this report are correct and that the field assembly construction of all parts of this vessel conforms with the requirements of ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. U Certificate of Authorization Number \_\_\_\_\_ Expires \_\_\_\_\_

Date \_\_\_\_\_ Name \_\_\_\_\_ Signed \_\_\_\_\_  
(Assembler) (Representative)

## CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and employed by \_\_\_\_\_,

have compared the statements in this Manufacturer's Data Report with the described pressure vessel and state that parts referred to as data items \_\_\_\_\_, not included in the certificate of shop inspection, have been inspected by me and to the best of my knowledge and belief, the Manufacturer has constructed and assembled this pressure vessel in accordance with the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of \_\_\_\_\_. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date \_\_\_\_\_ Signed \_\_\_\_\_ Commission \_\_\_\_\_  
(Authorized Inspector) [National Board (incl. endorsements)]