Appendix G

Hydrodec of North America, LLC

Mechanical Integrity Program

1.0 Scope

Hydrodec's Mechanical Integrity Program (MIP) is intended to ensure equipment does not fail in a way that causes a release of highly hazardous chemicals. Hydrodec's MIP covers the proper design, fabrication, construction / installation, and operation of equipment throughout the entire process life cycle. Although maintenance is a major part of an MIP, MIP is not just maintenance. Other activities are involved such as training and quality assurance. The Hydrodec MIP covers these areas:

- Management system
- Identification and categorization of covered equipment
- Applicable codes and standards
- Inspection and testing
- Correction of deficiencies in equipment

The scope of Hydrodec of North America's Mechanical Integrity Program covers selected process equipment, process piping, rotating equipment, and instrumentation and is intended to prevent the release of highly hazardous chemicals.

2.0 Computerized Maintenance Management System (CMMS)

The Hydrodec of North America Canton Plant uses a computerized maintenance management system (CMMS) (TabWare PM Module) to help administer the maintenance function. Specifically, the CMMS system is used to:

- Initiate and track preventive maintenance work orders
- Initiate and track corrective maintenance work orders
- Maintain or reference job plans
- Track equipment repair history
- Track work order backlog

3.0 Vessels

3.1 List of Equipment

3.1.1 A complete list of covered equipment is shown in Appendix A. Note that the bulk hydrogen tank is owned by the supplier (Praxair) and the supplier is responsible for inspection and maintenance activities associated with this tank. Hydrodec personnel visually monitor this tank and associated hardware and notifies Praxair in the event of any unusual observations.

3.2 Selection Criteria

3.2.1 Vessels were selected for inspection based on a combination of the following criteria: Service, pressure, temperature, material of construction, historical experience, risk factor (probability and consequence of failure) and location in the process.

3.3 Description of Inspection

3.3.1 Vessels will receive both a Visual Inspection and an Ultrasonic Thickness Test.

3.3.1.1 Visual Inspection

A visual inspection is applicable to all pressure vessels and tanks covered under the mechanical integrity program. A direct visual inspection shall be conducted where access is sufficient to place the eye within 24 inches of the surface to be examined and at an angle not less than 30 degrees to the surface to be examined. In the event a direct visual inspection is not achievable, a remote visual inspection shall be conducted of the required surfaces. This method of visual inspection may use visual aids such as mirrors, telescopes, borescopes, fiber optics cameras or other suitable instruments. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual inspection

3.3.1.2 Ultrasonic Thickness Testing

Ultrasonic Thickness Testing is applicable to pressure vessels and tanks that are manufactured from any material provided the sound velocity and a suitable calibration block are available.

A sufficient number of measurements on each pressure vessel or tank shall be made to ensure that areas having possible wall thickness degradation problems are found. If wall degradation is suspected on a pressure vessel or tank, a detailed mapping of the suspected area(s) shall be performed.

The acceptance criteria for a particular pressure vessel or tank are determined by evaluating the measured thicknesses against the original design thickness of the vessel. Calculations may be necessary to disposition results. It is not the responsibility of the inspector to determine the acceptance criteria for ultrasonic thickness tests. Final assessment on equipment acceptance will be made by Hydrodec Engineering management.

3.4 Inspectors and Qualifications

Personnel performing inspections in accordance with this procedure shall be qualified and certified in accordance with American Society for Nondestructive Testing (ASNT) SNT-1A standards. (No. SNT-TC-1A)

- An NDT Level I individual should be qualified to properly perform specific calibrations, specific NDT and specific evaluations for acceptance or rejection determinations according to written instructions and to record results. The NDT Level I should receive the necessary instruction and supervision from a certified NDT Level II or III individual.
- An NDT Level II individual should be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable codes, standards and specifications. The NDT Level II should be thoroughly familiar with the scope and limitations of the methods for which he is qualified and should exercise assigned responsibility for on-the-job training and guidance of trainees and NDT Level I personnel. The NDT Level II should be able to organize and report the results of NDT tests.
- An NDT Level III individual should be capable of developing, qualifying and approving procedures, establishing and approving techniques, interpreting codes, standards, specifications and procedures, as well as designating the particular NDT methods, techniques and procedures to be used. The NDT Level III should be responsible for the NDT operations for which he is qualified and assigned and should be capable of interpreting and evaluating results in terms of existing codes, standards and specifications. The NDT Level III should have sufficient practical background in applicable materials, fabrication and product technology to establish techniques and to assist in establishing acceptance criteria when none are otherwise available. The NDT Level III should have general familiarity with other appropriate NDT methods, as demonstrated by an ASNT Level III Basic examination or other means. The NDT Level III, in the methods in which he is certified, should be capable of training and examining NDT Level I and II personnel for certification in those methods.

Inspections can be carried out by Level I technicians and above, however, reports and evaluations must be conducted only by Level II and Level III inspectors

3.5 Timelines and Schedules

3.5.1 Base-line ultrasonic thickness inspections were conducted and recorded in 2015 prior to plant commissioning. Ultrasonic vessel inspections will initially be scheduled every three years. If no changes in thickness or surface quality manifest themselves in two consecutive inspections, the inspection interval may be changed to 5 years. A change in inspection interval will require an MOC (Management of Change).

3.5.2 A monthly visual inspection of the covered vessels will be conducted by one of the following individuals: Senior Process Engineer, Operations Supervisor, or the

Plant Manager. A checklist will be used to record the inspection and any deficiencies recorded and addressed in the CMMS.

4.0 Piping Systems

4.1 List of Piping Systems

4.1.1 A complete list of covered Piping is shown in Appendix B

4.2 Selection Criteria

4.2.1 Piping Systems were selected for inspection based on a combination of the following criteria: Service, pressure, temperature, material of construction, historical experience, risk factor (probability and consequence of failure) and location in the process.

4.3 Inspection Description

4.3.1 Piping Systems will receive both a Visual Inspection and an Ultrasonic Thickness Testing.

4.3.1.1 Visual Inspection

A visual inspection is applicable to all piping systems selected under the mechanical integrity program. A direct visual inspection shall be conducted where access is sufficient to place the eye within 24 inches of the surface to be examined and at an angle not less than 30 degrees to the surface to be examined. In the event a direct visual inspection is not achievable, a remote visual inspection shall be conducted of the required surfaces. This method of visual inspection may use visual aids such as mirrors, telescopes, borescopes, fiber optics cameras or other suitable instruments. Such equipment shall have a resolution capability at least equivalent to that obtainable by direct visual inspection.

4.3.1.2 Ultrasonic Thickness Testing

Ultrasonic thickness testing is applicable to piping systems that are manufactured from a metallic and non-metallic material provided the sound velocity and a suitable calibration block are available. Thickness measurement locations must be identified at points on a component or along a piping system where the inspections are made. Details of complete insulation removal or insulation plug removal for ultrasonic thickness testing inspection on pipes and components so equipped shall be specified on the PM work order. If wall thinning is suspected, a detailed thickness mapping of the suspected area(s) shall be performed.

The acceptance criteria for a particular piping system are determined by evaluating the measured thicknesses against the original design thickness of the piping system or component. Calculations may be necessary to disposition results. It is not the responsibility of the inspector to determine the acceptance criteria for ultrasonic thickness testing. Final determination of the acceptance of a piping system will be performed by the Senior Process Engineer or the Plant Manager.

4.4 Inspectors and Qualifications

Personnel performing inspections in accordance with this procedure shall be qualified and certified in accordance with American Society for Nondestructive Testing (ASNT) SNT-1A standards. (No. SNT-TC-1A)

Inspections can be carried out by Level I technicians and above, however, reports and evaluations must be conducted only by Level II and Level III inspectors

4.5 Timelines and Schedules

4.5.1 Base-line ultrasonic thickness inspections were conducted and recorded in 2015 prior to plant commissioning. Ultrasonic thickness inspections will initially be scheduled every two years. If no changes in thickness or surface quality manifest themselves in two consecutive inspections, the interval may be changed to three years. A change in inspection interval will require an MOC.

4.5.2 A monthly visual inspection of the covered piping systems will be conducted by one of the following individuals: Senior Process Engineer, Operations Supervisor, or the Plant Manager. A checklist will be used to record the inspection and any deficiencies recorded and addressed in the CMMS.

5.0 Rotating Equipment

5.1 List of Rotating Equipment

5.1.1 A complete list of covered rotating equipment is shown in Appendix C

5.2 Selection Criteria

5.2.1 The specified Rotating Equipment were selected for inspection based on a combination of the following criteria: Service, pressure, temperature, material of construction, historical experience, risk factor (probability and consequence of failure) and location in the process.

5.3 Inspection Description

5.3.1 Inspections for Rotating Equipment will be performed using the manufacturer's recommendations for inspections and preventative maintenance.

5.4 Timelines and Schedules

5.4.1 Inspections and preventative maintenance will be performed in accordance with the Manufacturer's recommendations.

5.4.2 A monthly visual inspection of the covered rotating equipment will be conducted by one of the following individuals: Senior Process Engineer, Operations Supervisor, or the Plant Manager. A checklist will be used to record the inspection and any deficiencies recorded and addressed in the CMMS.

6.0 Instrumentation

6.1 List of Instrumentation

6.1.1 A complete list of instrumentation is shown in Appendix D

6.2 Selection Criteria

6.2.1 The specified Instrumentation were selected for inspection based on a combination of the following criteria: Service, pressure, temperature, material of construction, historical experience, risk factor (probability and consequence of failure) and location in the process.

6.3 Inspection Description

6.3.1 Inspections for Instrumentation will be performed using the manufacturer's recommendations for inspections and preventative maintenance.

6.3.2 Inspections will be performed by either the Controls Engineer or the Instrument technician. Persons performing inspections will follow the instructions in the manufacturer's manual.

6.3.3 Calibrations will be performed by either the Controls Engineer or the Instrument technician. Persons performing calibrations will follow the instructions in the manufacturer's manual.

6.4 Timelines and Schedules

6.4.1 Preventative maintenance and calibrations will be performed in accordance with the Manufacturer's recommendations

6.4.2 A monthly visual inspection of the covered instrumentation will be conducted by one of the following individuals: Controls Engineer, Instrument technician, Senior Process Engineer, Operations Supervisor, or the Plant Manager. A checklist will be used to record the inspection and any deficiencies recorded and addressed in the CMMS.

Appendix A. List of Covered Equipment

Plant 1		**Plant 2**		**Plant 3**		**Facility**
CP-114		CP-114		CP-114		VE-840
CP-124		CP-124		CP-124		Henek Vacuum Chamber
CP-213		CP-213		CP-213		Henek Overflow Chamber
CP-214		CP-214		CP-214		
HX-111		HX-111		HX-111		
HX-121		HX-121		HX-121		
HX-211		HX-211		HX-211		
RA-113		RA-113		RA-113		
RA-123		RA-123		RA-123		
SC-213		SC-213		SC-213		
SC-214		SC-214		SC-214		
TK-245		TK-245		TK-245		
TK-251		TK-251		TK-251		
VE-117		VE-117		VE-117		
VE-127		VE-127		VE-127		
VE-201		VE-201		VE-201		
VE-202		VE-202		VE-202		

VE-203		VE-203		VE-203		
VE-212		VE-212		VE-212		

Appendix B. List of Covered Piping

Plant 1		**Plant 2**		**Plant 3**		**Facility**
CO117 & CO127 piping		CO117 & CO127 piping		CO117 & CO127 piping		Hydrogen Storage Piping
VE-117 Piping		VE-117 Piping		VE-117 Piping		Hydrogen Compressor Piping
Ve-127 Piping		Ve-127 Piping		Ve-127 Piping		VE-840 Piping
RA-113 Offgas Piping		RA-113 Offgas Piping		RA-113 Offgas Piping		Vent Line to Thermal Oxidizer
RA-123 Offgas Piping		RA-123 Offgas Piping		RA-123 Offgas Piping		
RA-113 Inlet/Outlet Piping		RA-113 Inlet/Outlet Piping		RA-113 Inlet/Outlet Piping		
RA-123 Inlet/Outlet Piping		RA-123 Inlet/Outlet Piping		RA-123 Inlet/Outlet Piping		
SC-213 Piping		SC-213 Piping		SC-213 Piping		
SC-214 Piping		SC-214 Piping		SC-214 Piping		
VE-201 Piping		VE-201 Piping		VE-201 Piping		
VE-202 Piping		VE-202 Piping		VE-202 Piping		
VE-203 Piping		VE-203 Piping		VE-203 Piping		
VE-212 Piping		VE-212 Piping		VE-212 Piping		

TK-245 Piping		TK-245 Piping		TK-245 Piping		

Appendix C. List of Covered Rotating Equipment

Plant 1		**Plant 2**		**Plant 3**		**Facility**
CO-117		CO-117		CO-117		CO-824
CO-127		CO-127		CO-127		CO-825
						CO-826
						PU-842

Appendix D. List of Covered Instrumentation

Plant 1			**Plant 2**			**Plant 3**			**Facility**
FE-01103	FE-02103		FE-01103	FE-02103		FE-01103	FE-02103		PT-84003
PV-11705	PV-12705		PV-11705	PV-12705		PV-11705	PV-12705		LT-84005
PIT-11705	PIT-12705		PIT-11705	PIT-12705		PIT-11705	PIT-12705		LT-84002
XV-11706	XV-12706		XV-11706	XV-12706		XV-11706	XV-12706		LS-84008
FE-11702	FE-12702		FE-11702	FE-12702		FE-11702	FE-12702		LS-84007
LS-11701	LS-12701		LS-11701	LS-12701		LS-11701	LS-12701		LS-84006
FV-11702	FV-12702		FV-11702	FV-12702		FV-11702	FV-12702		XV-84201
XV-11717	XV-12717		XV-11717	XV-12717		XV-11717	XV-12717		XV-84001
TE-11310	TE-12310		TE-11310	TE-12310		TE-11310	TE-12310		
PIT-11102	PIT-12102		PIT-11102	PIT-12102		PIT-11102	PIT-12102		
TE-11101	TE-12101		TE-11101	TE-12101		TE-11101	TE-12101		
FE-11312	FE-12312		FE-11312	FE-12312		FE-11312	FE-12312		
LV-11306	LV-12306		LV-11306	LV-12306		LV-11306	LV-12306		
XV-11313	XV-12313		XV-11313	XV-12313		XV-11313	XV-12313		
XV-20310	XV-20311		XV-20310	XV-20311		XV-20310	XV-20311		
TE-11201	TE-12201		TE-11201	TE-12201		TE-11201	TE-12201		
TE-11202	TE-12202		TE-11202	TE-12202		TE-11202	TE-12202		
TE-11203	TE-12203		TE-11203	TE-12203		TE-11203	TE-12203		

PIT-11314	PIT-12314		PIT-11314	PIT-12314		PIT-11314	PIT-12314		
PIT-11303A	PIT-12303A		PIT-11303A	PIT-12303A		PIT-11303A	PIT-12303A		
PIT-11303B	PIT-12303B		PIT-11303B	PIT-12303B		PIT-11303B	PIT-12303B		
PV-11303	PV-12303		PV-11303	PV-12303		PV-11303	PV-12303		
LS-11302	LS-12302		LS-11302	LS-12302		LS-11302	LS-12302		
LS-11301	LS-12301		LS-11301	LS-12301		LS-11301	LS-12301		
LIT-11306	LIT-12306		LIT-11306	LIT-12306		LIT-11306	LIT-12306		
TE-11309	TE-12309		TE-11309	TE-12309		TE-11309	TE-12309		
XV-20109	XV-20107		XV-20109	XV-20107		XV-20109	XV-20107		
XV-20110	LV-20102		XV-20110	LV-20102		XV-20110	LV-20102		
PIT-20105	TE-21205		PIT-20105	TE-21205		PIT-20105	TE-21205		
TE-20104	LS-21203		TE-20104	LS-21203		TE-20104	LS-21203		
LS-20103	LS-21201		LS-20103	LS-21201		LS-20103	LS-21201		
LS-20101	LIT-21202		LS-20101	LIT-21202		LS-20101	LIT-21202		
LIT-20102	XV-21204		LIT-20102	XV-21204		LIT-20102	XV-21204		
PIT-21305	LV-21202		PIT-21305	LV-21202		PIT-21305	LV-21202		
PIT-21405	XV-21307		PIT-21405	XV-21307		PIT-21405	XV-21307		
LIT-21302	LIT-21402		LIT-21302	LIT-21402		LIT-21302	LIT-21402		
LS-21303	LS-21403		LS-21303	LS-21403		LS-21303	LS-21403		
LIT-20201	XV-21308		LIT-20201	XV-21308		LIT-20201	XV-21308		
PIT-20202	PV-20202		PIT-20202	PV-20202		PIT-20202	PV-20202		
LV-20201A	LV20201B		LV-20201A	LV20201B		LV-20201A	LV20201B		
PIT-20307	LIT-20302		PIT-20307	LIT-20302		PIT-20307	LIT-20302		
PIT-20305	FE-20312		PIT-20305	FE-20312		PIT-20305	FE-20312		

PIT-30002	TE-20401		PIT-30002	TE-20401		PIT-30002	TE-20401		
FE-11718			FE-11718			FE-11718			