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**OPERATION AND INSTRUCTION MANUAL**

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**NORCLEAN POWERED EDDY CURRENT  
VACUUM RECOVERY SYSTEM**

**WITH WATER TRAP OPTION**

THIS SYSTEM IS TO BE USED FOR REMOVING CONTAMINATED  
DEBRIS FROM EDDY CURRENT PROBES DURING STEAM  
GENERATOR OUTAGE INSPECTIONS.

**SYSTEM DESIGN  
PRINCIPLE  
RIVER TECHNOLOGIES, LLC  
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Forest, Virginia 24551  
1-434-525-4735**

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## **IMPORTANT**

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Read all instructions carefully and completely before using this system.

Save this instruction manual. This manual contains important operating instructions for the eddy current inspection vacuum recovery system.

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## **CAUTIONS**

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Never use this system other than its intended purpose. Used properly, this system is designed to reduce radiation exposure to the work atmosphere inside containment, and to the operating decon personnel.

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## **WARNING**

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Do not leave this vacuum system unattended or running when plugged in. Unplug from outlet when not in use and before servicing.

Use only as described in this manual. Use only manufacturer's recommended attachments and filters.

Do not pull by or carry by the cord, use cord as a handle, or pull cord around sharp corners. Keep cord away from heated surfaces.

Do not unplug by pulling the cord. To unplug, grasp the plug, not the cord.

Do not handle vacuum system with wet hands.

Do not operate with any openings that would be fully clogged.

Do not pick up anything that is smoking or burning.

Do not use without all the proper filters in place as described in this manual.

Do not use for or near any combustible fluid or materials.

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## **I. VACUUM SYSTEM ASSEMBLY**

<b>P/N- B1099NO - Norclean model NAN – NEL 3 compact vacuum</b>
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### **1. Components**

1. P/N 1001010 disposable dust bag/5 pack.
2. P/N 0501001 pre filter bag.
3. P/N 0502020 HEPA filter.
4. P/N 0502051 HEPA filter clamp.
5. P/N 020211OX 3 motor electric power head.
6. P/N 0901301T suction drum.
7. P/N 1020033 suction inlet flap cover.

### **2. Assembly**

P/N B1099N0 vacuum system comes fully assembled and ready to connect the eddy current vacuum recovery hose assembly.



### **3. Filter Installation**

1. Insert disposable dust bag over the suction inlet located inside the suction drum and secure blow off strap on inlet or drape over drum lip.
2. Insert pre filter bag “conical shaped” over top of the suction drum lip.
3. Turn power head upside down and remove black knob on the filter clamp and set aside.
4. Slide HEPA filter over screw stem underneath power head filter clamp. Install rubber washer over stem and bottom plate on HEPA filter and screw on black knob.

5. Make a visual inspection of the HEPA filter so the seal is sitting flat on the bottom the power head lid. Grab filter and slide clockwise and counter clockwise to feel a snug fit, then give an extra turn on black knob to ensure a seal.
6. Turn power head over with mounted HEPA filter and insert into center of the mounted pre filter bag inside the suction drum.
7. Make sure fastener lockdown is adjusted to a snug fit between the power head and the suction drum.
8. Pull down eccentric fasteners on the suction drum and lock on power head, insert tamper evident cable seal through the wall of the fastener.
9. The system is now ready to enter the RCA and can be controlled by Rad Protection.

## **II. PRE FILTER ASSEMBLY**

### **1. Components**

1. P/N 9000100 pre filter assembly complete.
2. P/N 0502051 filter clamp.
3. P/N 0502020 HEPA filter.

### **2. System Connection**

The pre filter assembly comes fully assembled and ready for use. Connect the 10'-3" female x male cam lock hose section to pre filter with arrows pointing to vacuum. Connect other end to vacuum 3" x 2" hose reducer. Connect the 10'-3" hose section with female cam lock fittings on both ends to the male fitting on the pre filter going away from arrow direction on pre filter. After connections have been made it is time to apply the optional shielding apparatus over the pre filter assembly.  
" See Section X optional accessories, 3. Shielding".



### **3. Pre Filter Removal**

When the dose readings on the pre filter pass the designated level, discard the complete assembly. Remove the locking pins and pull the cam lock levers back and slide hose ends out from the front and back of the pre filter. Install a new pre filter in the reverse manner.

## **III. WATER TRAP ASSEMBLY**

### **1. Components**

1. P/N ECWT-002 transfer lid assembly.
2. P/N ECWT-003 silo assembly.
3. P/N ECWT-007 holding cart assembly.

### **2. System Connections**

The water trap assembly comes fully assembled and ready for use. Connect the 3.0" female cam lock x 10' hose section to the 3" male cam lock marked inlet on the silo lid. Connect the 3.0" female cam lock x 10' hose section to the 3.0" male cam lock silo lid marked outlet to pre filter.



**This side to manifold**

**This side to pre filter**

After hose sections have been installed, make sure the discharge ball valve on the bottom of the water trap is in the closed position. Install 3/4" garden style water hose line to the silo lid top.

### 3. Operation

The water trap is designed to collect and discharge contaminated debris that fall out into the scrubber assembly during the eddy current inspection process.

Water Trap needs to be monitored by Radiation Protection during operation. Water Trap systems needs to be drained and flushed when dose rate limits are reached.

The water trap is not 100 percent effective for stopping all the contamination in the suction lines during the inspection process. Therefore, The pre filter trap has to be in place behind the water trap for 100 percent retention of the contaminated debris in the suction line. This set up will keep the vacuum from seeing any contamination other than background levels.



Make sure the discharge ball valve on the bottom of the silo is in the closed position. Close all the ball valves on silo lid. Install  $\frac{3}{4}$ '' garden hose to the silo lid water connection. Pressurize the water hose.

Connect  $\frac{3}{4}$ '' female cam lock to the  $\frac{3}{4}$ '' male cam lock on discharge ball valve. Install desired  $\frac{3}{4}$ '' discharge hose to the female cam lock.

Open the garden hose connection ball valve. Open the ball valve marked silo fill valve, as the water starts to fill the silo, watch for the desired water level on the silo water level tube.



**Desired water level**

## **WARNING**

If the water level in the silo is higher than shown above, water will come out of the top lid suction outlet when the vacuum generator is engaged. This will saturate the pre filter and eventually fill the vacuum with contaminated water.

## **DO NOT OVER FILL THE SILO HOPPER**

Once the water level has reached the desired level, shut off the filling ball valve. The water trap is now ready to operate for the eddy current inspection process.

During the eddy current inspection the vacuum recovery system will suction up the debris that fall out in the scrubber attachments. The debris will plate out on the water surface in the water trap. The air borne fines that do not plate out in the silo will get trapped in the dry pre filter in line behind the water trap.

When dose in the water trap reaches the designated level, shut off the vacuum system. Open the discharge ball valve on the bottom of the silo and empty the contents of the water trap. Close the discharge valve.



Open the filling ball valve on top the silo lid and fill to the designated level with fresh water. Once the desired water level is achieved, turn on the vacuum generator and restart the eddy current vacuum recovery operation.

When the eddy current inspection process comes to a close, shut off the vacuum generator. Discharge the contents of the silo and leave the discharge ball valve open. Turn off the filling ball valve on the silo lid. Open the ball valve marked “flushing” and clean out the internal components of the silo collection hopper. When the cleaning cycle is complete, and the silo contents have drained out of the collection hopper, close the discharge ball valve.

**NEVER TURN ON THE VACUUM GENERATOR WHEN THE WATER TRAP DISCHARGE VALVE IS IN THE OPEN POSITION**



**DISCHARGE VALVE IN THE CLOSED POSITION**

## **WARNING**

Do not disconnect any of the suction hose lines. With the silo empty, turn on the vacuum generator to relieve the system of any contaminated water in and around the water trap. This will eliminate any water spillage when the system is taken down and removed from containment.

## **IV. HOSE ASSEMBLY**

### **1. Manifold**

The manifold P/N 9000120 is used to connect the four suction lines simultaneously with 1.5'' x 15' and 1.25'' reducing suction lines as the starting point from the eddy current scrubber attachments.

The manifold 3.0'' trunk outlet connects to the water trap angled inlet with a 3.0'' x 10' foot section of hose which has cam lock fittings at both ends.

### **2. Vacuum Suction Lines**

1. 4- 1.5'' ID x 15' vacuum suction line with air inducing valve and 3' x 1.25'' connection adapter hose.
2. 2- 3.0'' ID x 10' female to female cam lock suction line.
3. 1- 3.0'' ID x 10' male to female cam lock suction line.
4. 1- 2' x 3.0'' x 2.0'' reducer with 2.0'' connector pipe to the vacuum.

### **3. System Connection**

1. Start at the vacuum and connect the 2.0'' connector pipe end that is attached to the 2' - 3.0'' x 2.0'' reducer to the vacuum inlet.
2. Connect the male cam lock end of the 3.0'' ID hose to the female cam lock fitting on the outlet of the pre filter assembly.
3. Connect the 10' x 3.0'' ID hose section with the female cam lock to the male cam lock rear end of the pre filter.
4. Connect the female cam lock fitting of the 10' x 3.0'' ID hose to the 3.0'' male cam lock on the front of the pre filter.
5. From the front of the pre filter, connect the 3.0'' x 10' hose section to the male cam lock on the top of the water trap marked outlet.
6. From the top of the water trap lid marked inlet, connect 3.0'' x 10' hose section to the male cam lock on the manifold.
7. Connect the 15' x 1.5'' ID female cam lock hose sections ( 4 ) to the male cam lock fittings on the front of the manifold.
8. Connect the loose end of the 15' x 1.5'' hose section to the scrubber 1.25'' connection adapter.

**NOTE:** There is only one way the system can be connected. Make sure the pre filter is mounted behind the water trap. This insures the correct hose connections.

## **V. SYSTEM OPERATION**

### **1. Operation Description**

The S/G eddy current vacuum recovery system is designed to capture, contain and collect contaminated debris from the eddy current probe that falls out into the scrubber. This system will have four 1.5" ID x 15' hose suction lines connected to the scrubber attachment. These lines will convey contaminated material to the water trap first, then to the pre filter assembly for collection and disposal. The air borne material will plate on the water surface in the water trap. The pre filter which is HEPA rated at 99.997% at 0.3 micron size particles will trap any residual particulate that does not trap on the water surface. The remaining air flow will convey through 3.0" ID suction line to the Norclean vacuum system where the material will transfer through the absolute filter kit arrangement on the suction side of the vacuum and finally into the atmosphere.

The water trap and pre filter arrangement can be staged as much as 25' away from the S/G platform and the vacuum generators can be staged as far as 25' from the water trap and pre filter assembly. With these convey lengths the collection area will have room to stage a temporary shielding apparatus around the water trap and pre filter where 95% of the dose will occur. When the task at hand is done the pre filter assembly can be disconnected and bagged and drummed for removal from the RCA.

One complete vacuum recovery system will service one steam generator at a time. If there are multiple inspections going on at once during an outage then the service group would have to install a complete recovery system for each inspection.

### **2. Operation Details**

Install the absolute filter kit, as described in section I. Engage the fasteners and install a tamper evident cables for the work order at hand. The vacuums are now ready to enter containment and can be controlled by Health Physics.

Connect all the hose sections as described in section IV. "Hose Assembly" to the vacuum and water trap pre filter assembly. Fill the water trap with water as described in section III. "Water Trap Assembly". Before the system is used for eddy current recovery it is the recommendation of River Technologies that an in place D.O.P. test be performed to insure system HEPA filtration.

### **3. Shielding**

The water trap and pre filter housing are the main components that would require dose shielding. The water trap is going to see 95% of the contamination from the eddy current inspection process. The dose levels determine when to empty the water out of the trap. Distance from the discharge manifold is important when it is time to empty. The water trap is more difficult to shield due to the size. The pre filter is designed to disconnect in less than 20 seconds. It is up to the utility to shield and monitor both the water trap and pre filter assemblies. To completely remove the pre filter simply pull the cam lock locking pins, pull back the closing handles and disconnect two female cam lock hose fittings and install a new pre filter. The water trap is designed to stay with the system until the eddy current inspection is complete. To cut the dose down on the water trap, empty the contents and fill with new water. At the end of the inspection cycle, flush out the water trap with the flushing system on top the water trap lid to reduce any remaining dose.

### **4. Power On**

The vacuum system is electric powered and requires a 120v circuit rated at **20 amps**. The Norclean electric system has a 3 motor setup that can run continuously for 2400 hours. This rating is based on 70 degrees @ sea level and .075 density. If the operating atmosphere rises above 115 degrees the motors will start to fail sooner. From our design calculations, based on Norcleans recommendations, the suction flow for each scrubber connection is 40scfm – 65scfm, this will keep the debris from falling out of the air stream and into the vacuum lines instead of the water trap and pre filter housing.

## **VI. ADVANCE FUNCTIONS**

### **1. System Staging**

The vacuum systems are on mobile trolleys that can be pushed up to or carried to the area that is to be worked on. Small in size ( 24" x 15") @ 35lbs. The pre filter can sit at any level. From a vacuum performance stand point and to best utilize the system it would be advised to keep the vacuum at the lowest level and the scrubber at the highest level with the pre filter somewhere in the middle with more of a straight line if possible, small in size 12" x 12" x 15 lbs. The water trap which is larger in size than the pre filter, must have enough room in the work area to be put in line with the recovery system. The water trap must always be in front of the pre filter trap.

## 2. Vacuum Openings

The vacuum recovery system is designed to run all four openings from the scrubber simultaneously. Even if only two scrubbers are being used for tube inspection the other two lines should be open. Perform a visual inspection to verify there are no openings in the system other than at the scrubber itself. If the system is operated with any other openings, it will not perform as specified.

## 3. Air Induction Valves



**All four 1.25" suction lines connect to scrubber attachments**

The probe sleeve becomes pressurized when the vacuum recovery 4 way connections are made. This in turn puts vacuum pressure at the end of the probe sleeve and just below the S/G tube sheet. The purpose of the 4 air inducing valves is to take vacuum pressure away from the eddy current probe sleeve end, located just below the S/G tube sheet. Start out with all four gate valves closed and check for positive pressure ( no leaks in the system ). During the inspection process the inspection team finds that the scrubber and probe drivers are seeing higher than normal dose readings, then the vacuum is pulling too much contamination from the tube sleeve end. To balance the dose between the probe pusher and the water and pre filter trap, open the air inducing gate valves 1.25 turns on all four valves. This will relieve the vacuum pressure at the tube sheet. The contamination levels will start to build up at the pre filter trap which is the sole purpose of the system design. If the contamination starts to build up in the probe driver or scrubber, then the system may not have enough suction to pull the debris out of the scrubber. This balance is based solely on the dose levels and has to be done by field personnel at each inspection site.

#### **4. General Decon**

Once the eddy current inspections are complete the vacuums can be used for general cleaning in and around other areas from the platform and below. Simply disconnect the hose assembly and connect some 2.0" ID suction hose to the vacuum inlet for dry debris collection only. The vacuum has a disposable dust bag for large debris filtration and removal.

#### **5. Decon Shop**

When the vacuums have performed their task and are ready to be returned to the decon shop for servicing, once inside the shop remove the tamper seal from the vacuum fastener locking device. Visually inspect the system for any seal leakage between all the components. Turn on the vacuum to see if it is pulling maximum vacuum @ 80"wg. If maximum vacuum is not present, either the filters are loaded or there is a break in the seal between all the components. Remove dust bag, pre filter bag and leave HEPA in place unless there is a rad level problem. Reinstall the components with the HEPA still mounted under the power head and power on the system to achieve maximum vacuum. If full vacuum is not present remove outer cover from the top of the power head and see if all motors are turning before discarding the HEPA filter. Decon the inside of the vacuum system and reinstall new filters as needed and reapply tamper seals on the vacuumfastener locking device. The system is now ready to return to a lock up cage for the next work order in the RCA.

### **VII. TROUBLE SHOOTING**

#### **1. Power head**

The Norclean power head used in this system is a 3 motor arrangement with two sets of motor brushes for each motor. The power head is rated at 80" w.g. pressure and 270 scfm flow for the total performance curve. In the event the the maximum power is questioned, remove the upper bonnet and turn on the vacuum to see if all 3 motors are turning. If any of the motors do not turn on, inspect the motor brushes and replace if needed. If all motors are turning and there is weak suction on the vacuum inlet then the seal between the mounting lid and the motor bottom would be in question. Remove the second tier bonnet and remove motors and inspect O ring and bottom white gasket to insure proper seal is achieved. Do this procedure with no filters engaged on the power head. Other standard electrical testing procedures would apply to make the system function as designed. " See section IX, 4. Trouble shooting".

## **2. No Vacuum Power**

If the system is completely connected and ready to use, but it has insufficient suction at the scrubber boxes, check for leakage in the vacuum hose and connections. If there are leaks, a large portion of the vacuum available may be diverted to the leaks, and not be available at the scrubber.

Make sure all the motors are turning as described above, under section “Power Head”. Make sure all filters are in place and not blocked by debris. Make sure there is no large debris stuck in the vacuum line causing a flow restriction.

**\* In most cases, insufficient vacuum can be traced to one of the following :**

**A. Leak in the system**

**B. Clogged Hose**

**C. Clogged filters**

## **3. Material Fall Out**

If the eddy current graphite fines are falling out of the air stream and into the suction hose before it reaches the water trap, check for maximum power at the scrubber first. Disconnect each hose section down the line and check for vacuum loss. This will enable the operator to find the area of vacuum loss and fix the system.

The Norclean flow calculations require at least 40 scfm – 65 scfm per 1.25” suction line to keep the material flowing and not fall out into the 1.5 “ ID suction hose.

If there is no pressure when the vacuum is disconnected to the pre filter hose assembly, then the filters inside the vacuum would be in question or the power head itself.

The entire system is grounded via ground wire hose with metal and plastic connections. It is advised to ground the vacuum and the manifold to a steel ground pole. This helps the graphite fines from plating out in the suction hose before it gets to the water and pre filter trap. “ See grounding clip next page”.



**Grounding clip mounts to vacuum base and connect to metal pole**

## **VIII. SPECIFICATIONS**

### **1. Vacuum Power**

Norclean power head NEL 3

**-3 motors, WIRED FOR GFCI**

-Voltage required: 120vac

-Current requirement: 18 amps ( rated ) connect to a **20amp** source.

-Frequency: 60Hz

-Power consumption: 2.4 kW

- Continuous duty

### **2. System Flow**

Maximum vacuum: 80" ( Wg )

Maximum flow: 270 SCFM

### **3. Filters**

1. P/N ECWT100 water trap.
2. P/N 9000100 pre filter , 99.997% @ 0.3.
3. P/N 0502020 vacuum HEPA, 99.997% @ 0.3.
4. P/N 0501001 vacuum pre filter bag, 10 micron nominal.
5. P/N 1001010 vacuum disposable dust bag, 50 micron nominal.

### **4. Hose and Connections**

1. P/N 9001005 complete hose assembly.
2. P/N 9000120 manifold, 3.0" x 4 - 1.5" aluminum.
3. P/N 9000125 air inducing valve.



## **IX. DRAWINGS SECTION**

### **1. SYSTEM LAYOUT**



**Vacuum to pre filter trap**



**Pre filter trap to water trap**

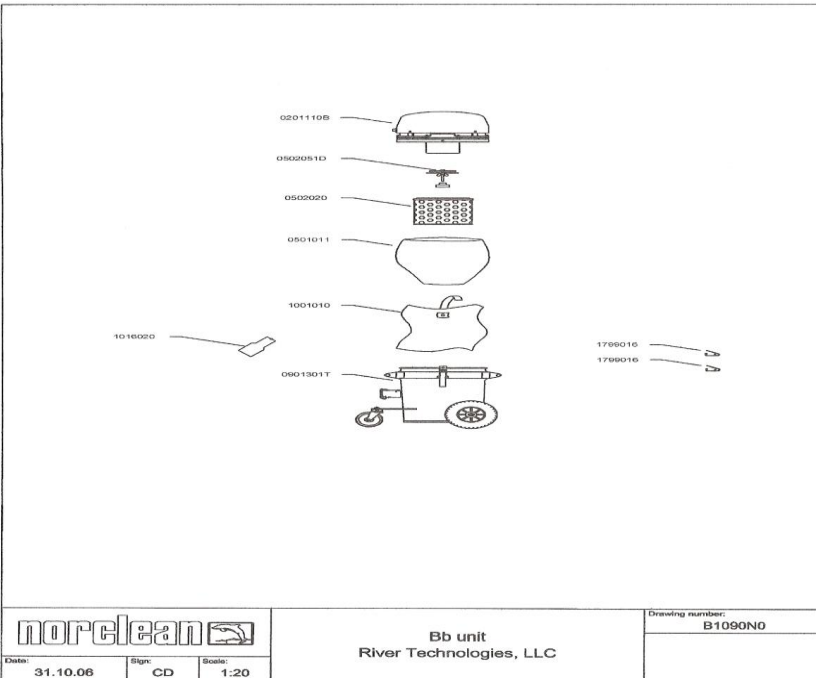


**Water trap to manifold**



**Manifold to scrubber/probe pushers**

2. VACUUM ASSEMBLY DRAWING



Vacuum generator

### 3. PRE FILTERS



**Water Trap- 42" x 38" x 38"**



**Pre filter- 12" x 12"**







**Manifold**


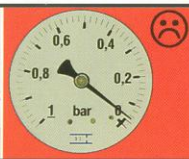









































**Air inducing valve**



#### 4. TROUBLE SHOOTING VACUUM

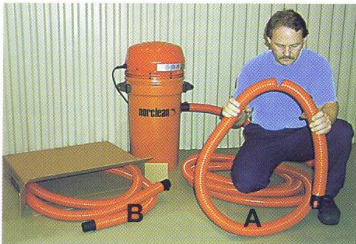
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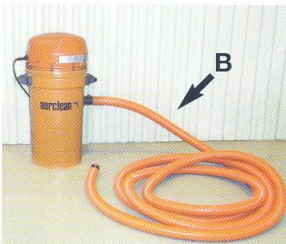






				
	  	 		
	 			
	 			
	 			
	 			
	 			
	 			
NEL 2R NEL 2 NEL 3 <b>-0,215bar -21,5kPa -2150mmWC</b> NEL 3R NEL 3RT				







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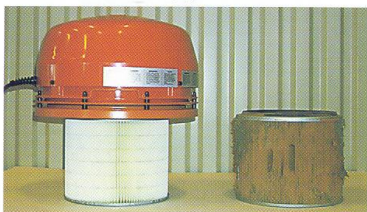
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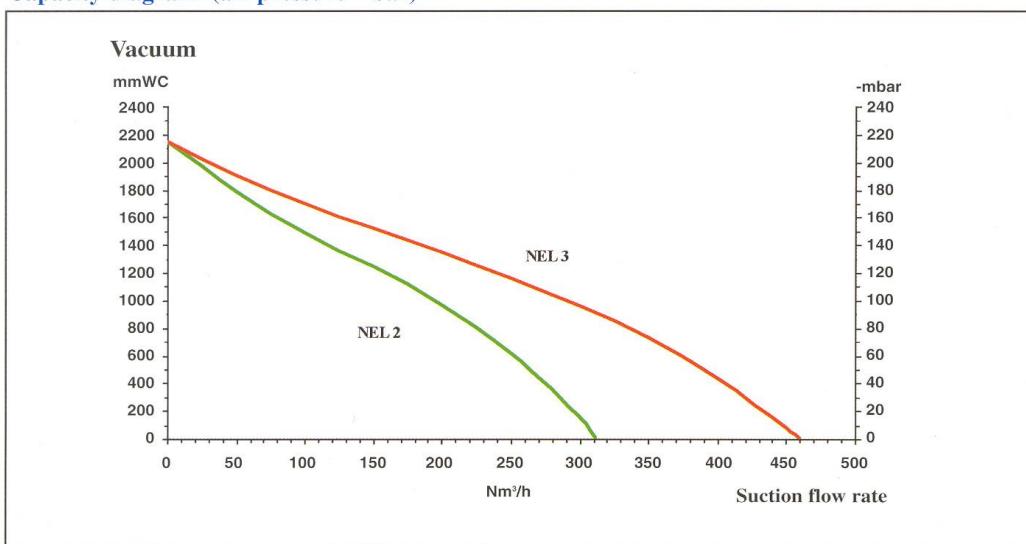
## 5. SPECIFICATIONS

### Technical data (power head)

Code no.	Type	Approvals	Power	Voltage	Max. Vacuum		Max. air-flow	Noise* level	Ø std. Suction hose
			kW	V,50/60Hz	mmWC	-mbar	Nm <sup>3</sup> /h	dB(A)	mm
02 01 011	NEL 2R	(N) IP44	1,6	230	2150	215	310	74	51
02 02 032	NEL 3R	(N) IP44	2,4	230	2150	215	460	75	51
02 02 042	NEL 3 RT	(N) IP44	2,4	230	2150	215	460	75	51

\* Measured at distance 3 m, height 1 m.  
 NEL 2R has 2 motors and all NEL 3 R/RT have three motors.  
 A multistage switch prevents the electric circuit from overloading.

### Capacity diagram (air pressure 7 bar)



### THE **norclean** PERFORMANCE – PRODUCT/SERVICE/EXPERIENCE – MEANS REAL VALUE

#### **norclean** Products:

We design and build the best quality and most innovative industrial vacuum systems available. We provide an extensive range of models with interchangeable components. Depend on **norclean** to custom design a system to meet your particular need or application.

#### **norclean** Service:

Our fully trained distributors and field service engineers can provide the prompt, professional service that you must have to solve your industrial cleaning problems. They are supported by a readily available stock of replacement parts.

#### **norclean** Experience:

By a careful reasearch of our customers' unique material handling needs, we have been able to produce industrial vacuum systems, which meet those needs efficiently and reliably. For more than 30 years, our products have been proven winners in diverse industries throughout the world.

We reserve the right to alter and redesign the product.



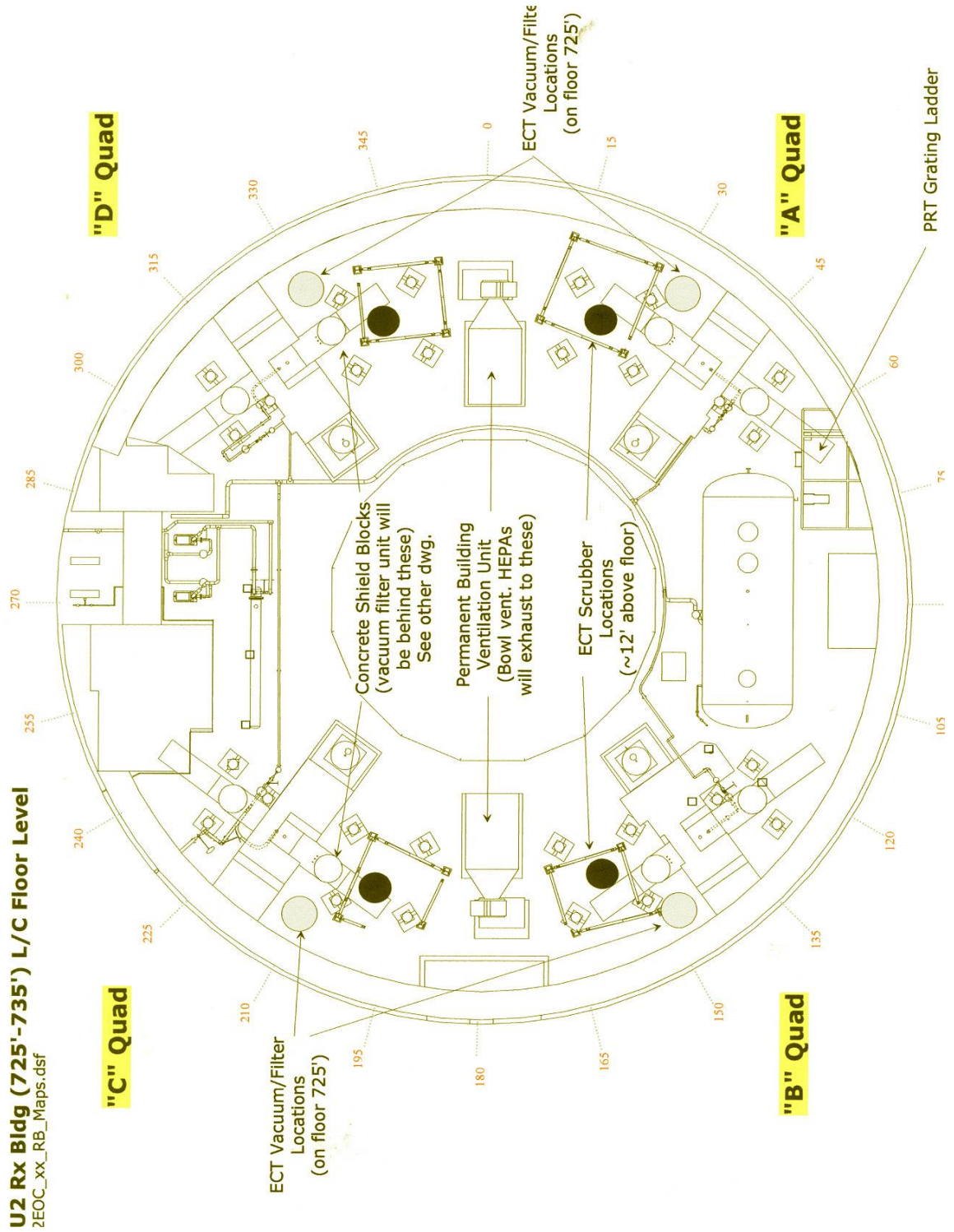
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<http://www.norclean.com> E-mail: [norclean@norclean.no](mailto:norclean@norclean.no)

**WARNING!**  
 If this unit shall be used for collection of hazardous, explosive or high flammable material, or in areas where such is present, get in touch with the manufacturer for technical advice !

BK Grafisk 10/2001



## 6. SYSTEM STAGING EXAMPLE



## **X. OPTIONAL ACCESSORIES**

### **1. Power head differential pressure gauge**



### **2. Run time meter/ individual motor on indicator lights**



### 3. Shielding



### 4. Storage box

