TRI NUCLEAR CORP.
THE INDUSTRY STANDARD IN UNDERWATER FILTRATION
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Skimmer Filter Pump

Operating Instructions and Maintenance Manual

For Model:

SFP-100

Operating Instructions and Maintenance Manual
Skimmer Filter Pump

For Model:
SFP-100

NOTE:
This OI-TNC-017 combines and replaces the previous Tri Nuclear Operating Instructions listed below (which are now obsolete).

Previous Document NO.	Revision	Issue Date	Title
OI-13	4.0	09/18/14	SFP-100 Operating Instructions
ACN-3	-	03/27/17	Digital Flow Meter Change

For information on legacy/obsolete Tri Nuclear equipment, please see the document:
OI-Legacy Rev 0 (Legacy descriptions and information for Tri Nuclear Underwater Systems)

Approval:	Date
Operations Manager John J. Flynn	21 Jan 2019

Tri Nuclear Record of Revision

Revision or Change Number	Effective Date of Revision or Change	Affected Page and / or Paragraph number	Person Entering Revision	Revision or change Cancelled By
Rev. 0	01/21/2019	Original Issue	----------	

If you have any questions concerning changes in this document, please call the main Tri Nuclear office at 518-399-1389 or e-mail at info@trinuclear.com

0.2 Front Matter – Table of Contents

0.2 Front Matter – Table of Contents (continued)

Attachments:

Number	Description	# of pages
TNC-017-02	Skimmer Filter Pump (SFP-100) Brochure Drawing	2
TNC-018-13	CB-xxx-FM Control Box Brochure Drawing	1
TNC-014-19	UT-9 Brochure Dwg	1
TNC-019-02	Filter Cartridge Brochure Drawing	1

0.3 Front Matter – ISO Safety Symbols - Defined

ISO Symbols	Meaning
	Yellow warning triangle/black graphical symbol, indicates what the hazard is. (Hazard Identification)
DANGER	**DANGER** - Indicates an imminently hazardous situation, which if not avoided, **will result in death or serious injury.**
WARNING	**WARNING** - Indicates a potentially hazardous situation, which if not avoided **could result in death or serious injury**
CAUTION	**CAUTION -** Indicates a potentially hazardous situation which, if not avoided, **may result in minor or moderate injury**
CAUTION	"**CAUTION"** without the safety alert symbol should be used for safety labels that indicate only equipment damage
NOTICE	**NOTICE** indicates information that relates directly or indirectly to the safety of personnel or protection of property

0.4 Front Matter – Precautions and Warnings

Symbol	Meaning
	General Caution: • Do not use this Equipment for any purpose not described in this Manual.
	**Danger:** • High Voltage • Do not operate this equipment from any power source that does not match the voltage rating stamped on the equipment. Refer to the Manufacturer's Identification Label for operational requirements.
	**Caution:** • Normal operation of this equipment will likely result in radioactive contamination. Decontamination must be performed in accordance with approved procedures.
	**Prohibited:** • Do NOT use tools. Hand tighten only.

DANGER	Do not submerge the control box for any reason.
	Ensure proper electrical safety precautions are taken if the cover of the control box is open and there is power to the control box.
WARNING	Do NOT attempt to perform maintenance on the control box while it is energized.
	It is expected that trained and qualified personnel will operate the unit. Radiological considerations and requirements are not included in this document and should be specifically addressed by the end user organization.
CAUTION	Do NOT use the electrical cables to lift the pump out of the water.
	Tri Nuclear's ergonomic testing has concluded that the control box be mounted between 2ft. - 6.5 ft. (0.6M and 1.99M) from the platform it will be used on.
CAUTION	Use of any components other than genuine Tri Nuclear replacement parts will void the warranty.
	Check for proper phase rotation before running the system. Running the pump in reverse will result in damage over time.

0.4 Front Matter – Precautions and Warnings (continued)

Type	Description
CAUTION	Caution should be taken to *NOT* store any plastic components (eg. filters or hoses) near high radiation fields associated with equipment such as fuel bundles, LPRM's or control blades. Breakdown of such components can occur with accumulated exposures of 10E6 Rad. For this reason, precautions should be taken to minimize accumulative dose for the following components: suction hose, filter cartridges, power and instrument cable, flow sensor, and electric motor. All components are chemically suitable for long term storage in the fuel pool cavity environment.
	If the pump trips on overcurrent due to being phased backwards, the overcurrent trip must be reset inside the CB-100P-FM control box before restarting. Allow the windings to cool down for at least two (2) minutes prior to restarting.
	The AS-2 Assembly Stand must be removed from the discharge of the pump prior to lowering into the Rx Cavity or Spent Fuel Pool. If the AS-2 is not removed, the SFP-100 will not operate properly and severe damage to the pump may occur due to running it without water and / or running it at shutoff head.
NOTICE	Perform a flow meter check: • Prior to initial installation • When a sensor is replaced • Sensor is suspected to be damaged
	UNLIKE Tri Nuclear Grundfos Pumps, the Prosser Pump may be started (bumped) while out of water to check for proper phase rotation. The "bump" is a start and immediate stop – which will be long enough to determine pump rotation and kick reaction.
	The direction of the pump "START KICK" and "IMPELLER ROTATION" are an integral part of the pump casing and are easily identified.
	If the pump is phased backwards, it WILL trip on overcurrent in a short (1 minute) period of time.
	If the pump is phased correctly it you will see 100-150 GPM flow on the Flow Meter. If it is phased backwards, you will see around 75 GPM (if the unit is in the water).
	Filter cartridges can take several minutes to flood while trying to submerge them in the pool. The flooding time can be minimized by pre-soaking the filters
	Running the unit without hoses will not produce desired results in surface water filtration.

1.0 Introduction

Tri Nuclear's SFP-100 is a self-contained portable surface water skimmer that is designed to be operated independent of any other Tri Nuclear or plant support equipment. It can operate efficiently with flow rates between 50 and 150 GPM.

The SFP-100 is designed to provide a skim perimeter of 9-1/2 ft. at flow rates between 50-150 GPM. This permits a thin overflow depth, which is necessary to effectively use water tension to skim pool surface water and not dilute the overflow stream with sub-surface water.

When putting the unit into operation, ballast water is added to initially adjust and maintain the correct floating level of the skimmer. The overflow trough directs the overflow water to the bottom outlet, through the filter, through the pump, and out the discharge diffuser.

The floating overflow weir consists of a polyester skirt banded to the OD of the overflow trough. The weir has an internal 1in flexible tube that maintains proper level control over variable flow rates of skimming operations

The following paragraphs and photographs describe the equipment components shown on Tri Nuclear drawing TNC-017-02.

1.1 Typical Operation

Unfiltered water from the cavity or spent fuel pool flows over the skimmer skirt, down through the skimmer trough, through a Tri Nuclear filter cartridge and into the pump. Filtered water is discharged into the discharge hose and diffuser, returning back to the cavity or spent fuel pool.

The filter in the filter housing is sealed by an O-ring mounted in the filter tube sheet. Negative pressure developed in the filter cartridges provide a positive seal between the filter cartridge and the mounted o-ring.

1.1.1 Design change for SFP's purchased after 2018

Due to the pump power cable twist lock plug and the digital flow sensor Amphenol connector, those cables are no longer have the ability to be fed through the clips on the filter housing and the SFP Upper float chamber. Now instead of having to disassemble the electrical connector on the pump power cable and the flow sensor Amphenol connector and feeding them through the SFP Upper float chamber, they can be tied off to the clips on the filter housing and the handle on the SFP Upper float chamber.

1.2 Environmental Conditions

With the exception of the electrical disconnect box, electrical controls, and the flow meter display, the Skimmer Filter Pump is designed to operate in the spent fuel pool and / or refueling pool water.

1.2.1 The Skimmer Filter Pump is designed to operate in continuous use in pure and / or borated water from 40F to 140F, PH ranges from 4.0 to 11.

1.2.2 The Skimmer Filter Pump components are designed for storage out of water in an ambient temperature range in air from 40F to +140F with 100% humidity.

1.3 Transportation and Storage

The Skimmer Filter Pump components will withstand, or has been protected against, transportation and storage temperatures of 40F to 140F. The systems have been packaged to prevent damage from the effects of normal humidity, vibration and shock.

1.4 Equipment Guide List

TNC Part Number	Description	SFP-100 Qty
SFP-100 Upper Float Chamber	36in dia skimmer upper float chamber. Contains the upper and lower buoyancy chambers.	1
SFP-100 Filter Housing	SFP-100 filter housing for (1) Tri Nuclear filter cartridge with 3in discharge Victaulic connection.	1
PP-100P-SFP	2-1/2HP/460V/3Ph/60Hz Prosser Style pump with 50' of non removable 12/4 SO power cable with twist lock plug.	1
CB-100P-FM	2-1/2 HP/460/3Ph/60 Hz phase reversing control box with twist lock plugs and integral 0-200 GPM digital flow meter.	1
PC-50	PC-50 drop cable with female plug (50ft Cable w/ female connector)	1
FM-SRD	Flow sensor with reinforced paddlewheel and 100ft cable with Amphenol connector.	1
PH-2x10	2in x 10ft suction hose with MxF camlock couplers	1
UT-8A-1.125	2in Diffuser pipe assembly x 14inlg. with an internal 1-1/8in orifice	1
GS-SFP-100-NP	1/8in thick neoprene gasket for sealing the Filter Tube and the SFP-100 Upper Float Chamber.	1
UT-10C	Mounting panel for PHASE REVERSING Control Box.	1
AS-2	Assembly Stand for assembling the SFP-100	1

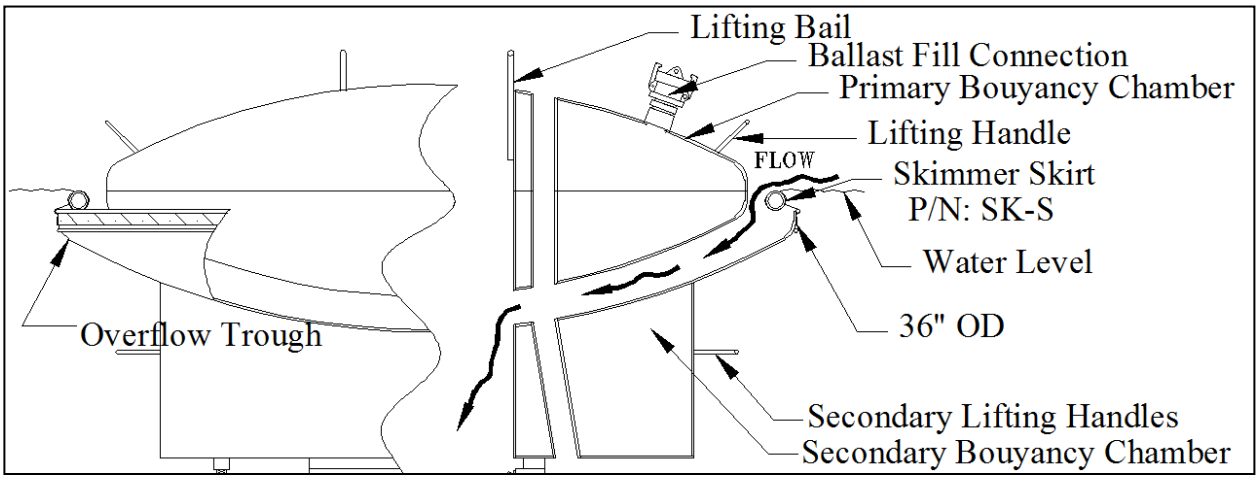
1.5 Materials of Construction

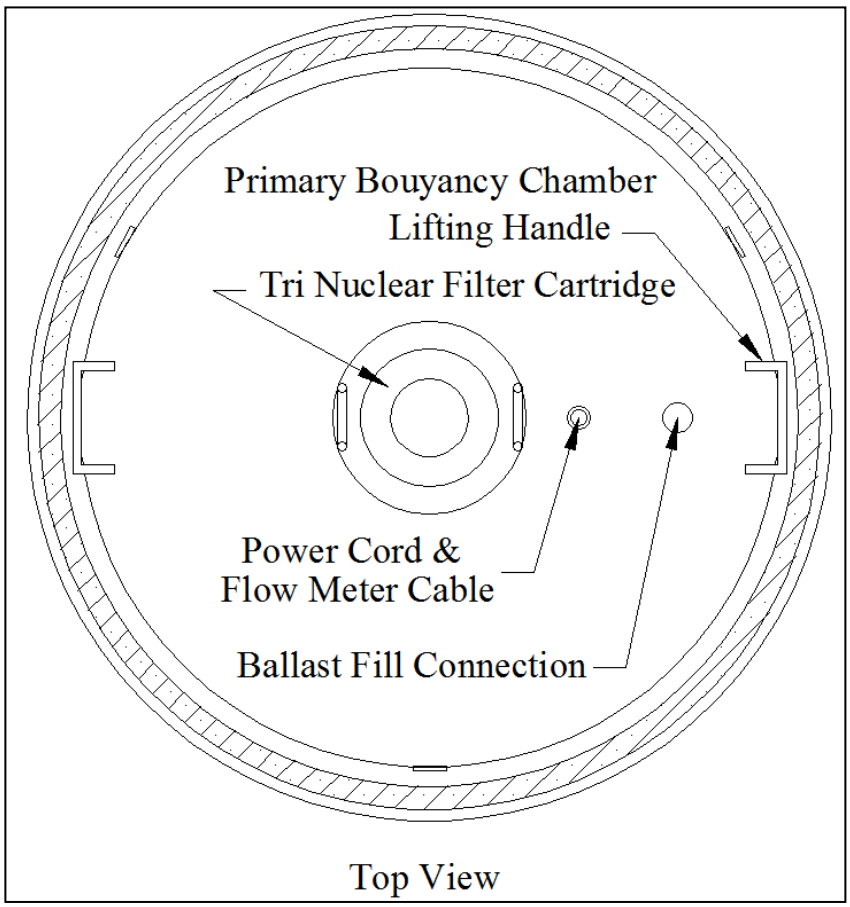
TNC Part Number	Description	Materials of Construction
SFP-100 Upper Float Chamber	36in dia skimmer upper float chamber. Contains the upper and lower buoyancy chambers.	304SS, 316SS
SFP-100 Filter Housing	SFP-100 filter housing for (1) Tri Nuclear filter cartridge with 3in discharge Victaulic connection.	304SS, 316SS, Buna N O-rings
PP-100P-SFP	2-1/2HP/460V/3Ph/60Hz Prosser Style pump with 50' of non-removable 12/4 SO power cable with twist lock plug.	Aluminum, 304SS, 316SS, 12/4 SOOW Cable
CB-100P-FM	CB-100P-FM PHASE REVERSING control box with twist lock plugs and integral digital flow meter.	Fiberglass Enclosure
PC-50	PC-50 drop cable with female plug (50ft Cable w/ female connector)	10/4 SOOW Cable
FM-SRD	Flow sensor with reinforced paddlewheel and 100ft cable with Amphenol connector.	Polypropylene
PH-2x10	2in x 10ft suction hose with MxF camlock couplers	PVC hose with Polypropylene camlock couplers & 304SS crimped sleeves
UT-8A-1.125	2in Diffuser pipe assembly x 14inlg. with an internal 1-1/8in orifice	304SS, 316SS
GS-SFP-100-NP	1/8in thick neoprene gasket for sealing the Filter Tube and the SFP-100 Upper Float Chamber.	neoprene
UT-10C	Mounting panel for PHASE REVERSING Control Box.	304SS
AS-2	Assembly Stand for assembling the SFP-100	304SS

2.0 Description of Equipment

2.1 SFP-100 Upper Float Chamber

This sub-assembly consists of the top primary buoyancy float welded with three legs to the overflow trough dished head, and the secondary sealed buoyancy float welded to the underside of the overflow trough. Both buoyancy floats have an internal cable way to allow for the passing of the pump power cable and flow meter cable. The primary buoyancy float also contains a 3/4in male camlock fitting to allow for the addition of ballast water.

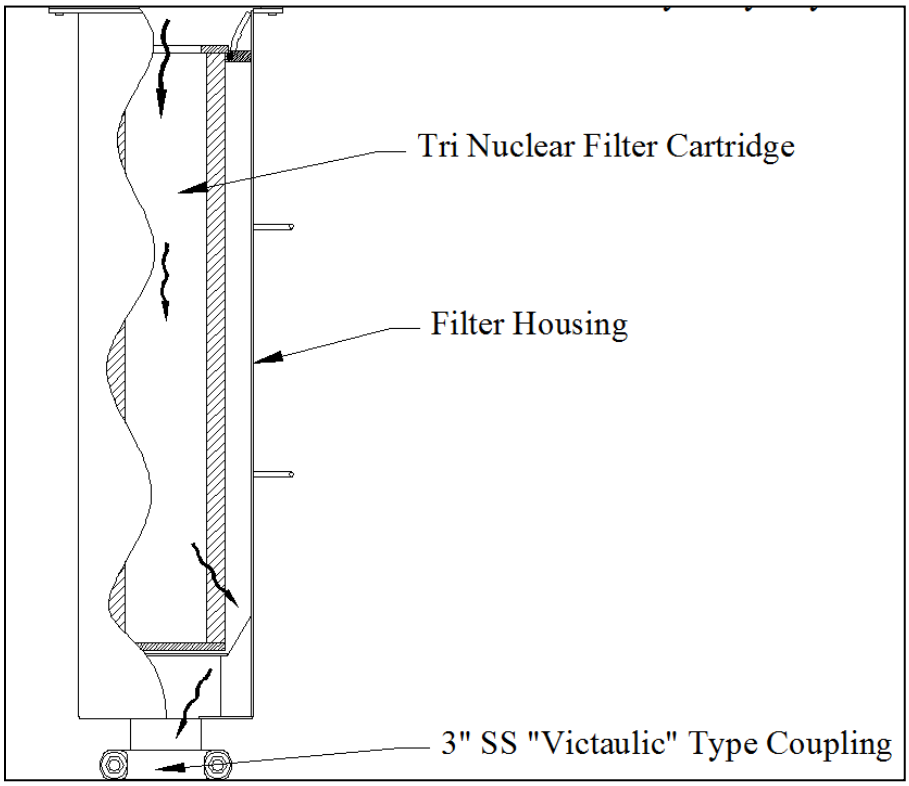

Lifting Bail
Ballast Fill Connection
Primary Bouyancy Chamber
Lifting Handle
FLOW
Skimmer Skirt
P/N: SK-S
Water Level
36" OD
Overflow Trough
Secondary Lifting Handles
Secondary Bouyancy Chamber


Primary Bouyancy Chamber
Lifting Handle
Tri Nuclear Filter Cartridge
Power Cord &
Flow Meter Cable
Ballast Fill Connection
Top View

SFP-100 Upper Float Chamber with skimmer skirt installed	
Figure 2.1 SFP-100 Upper Float Chamber	

2.2 SFP-100 Filter Housing

The SFP-100 Filter Housing bolts to the bottom of the secondary buoyancy chamber and is designed to hold one standard Tri Nuclear filter cartridge. There is a neoprene gasket that seals the filter housing to the bottom of the buoyancy chamber. The outlet of the filter housing uses a 3in Victaulic connection to connect with the suction of the pump.



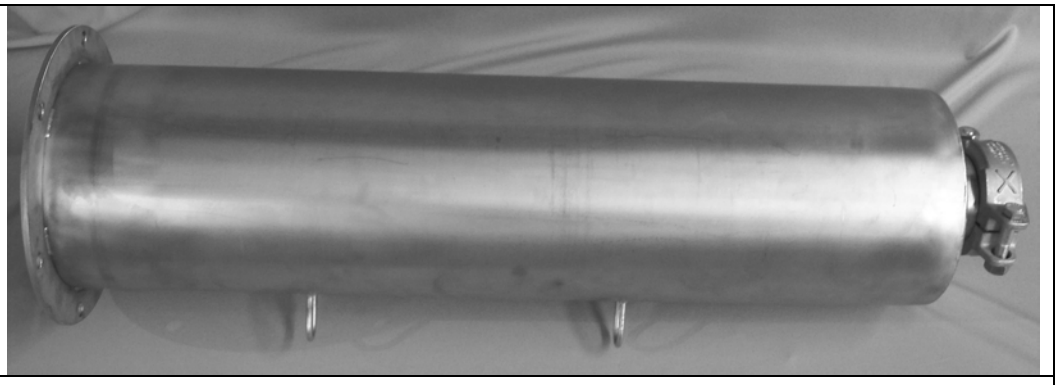
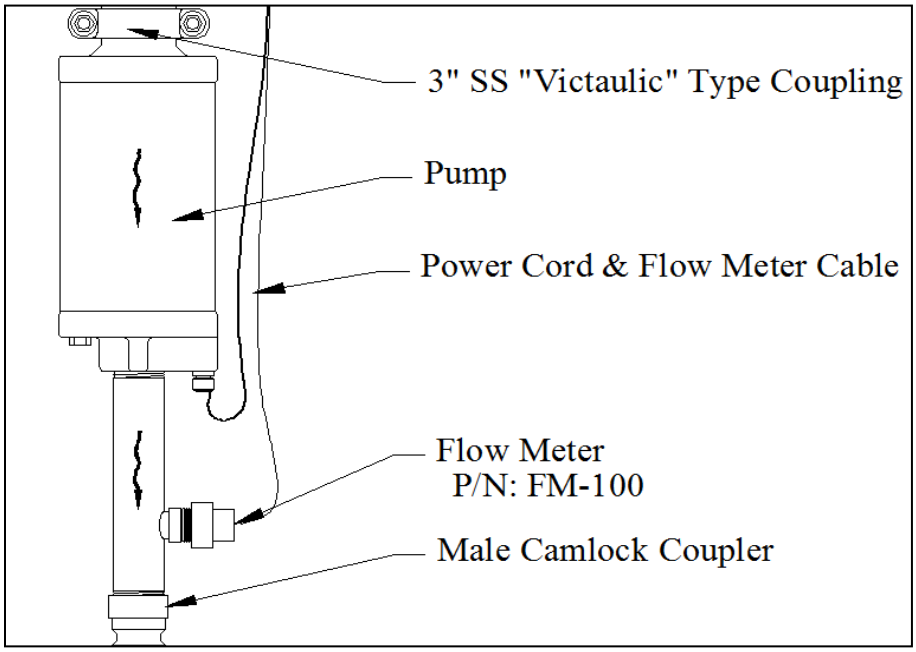
SFP-100 Filter Housing with 3in Victaulic coupling installed	

Figure 2.2
SFP-100 Filter Housing

2.3 SFP-100 Pump and discharge pipe

The pump is a 2-1/2HP, 460V/3Ph/60Hz single stage submersible centrifugal pump. The pump comes equipped with a 50ft "non-removable" SO power cable with a Twist Lock plug. There is a 2in male camlock attached to the end of the pump discharge pipe. The discharge pipe also contains the flow meter connection.



Pump Type	HP	Volt	Hz	NEMA Start Code	Amperage Full Load	Amperage Locked Rotor	Nominal Line to Line Resistance Blk–Yel Yel–Red Blk - Red
PP-100P	2.5	460	60	J	3.9	24.6	8.0 - 8.0 - 8.0

PP-100P Pump with 50ft non removable power cable, discharge pipe and flow meter fitting installed.	

Figure 2.3
SFP-100 Pump

2.4 Electrical Control Box (CB-xxx-FM)

All Tri Nuclear CB-xxx-FM control boxes are UL-508 certified.

The CB-xxx-FM is an IP66 / NEMA 4X type fiberglass (14x16) that has two 460V/3Ph/60Hz motor contactors/starters, a manual motor controller with short circuit protection and an adjustable over current trip. The control box has a “phase rotation switch” with safety cover, start/stop pushbuttons and a green “run” indicating light on the front of the panel. The control box includes an integral digital flow meter and Amphenol connection for the flow sensor connection on the front cover.

The phase reversing feature in this control box allows the operator to change the phase rotation of the pump WITHOUT having to open the control box and swap two of the three motor leads. This is accomplished by a switch on the front of the control box and two motor contactors/starters inside the control box. These two motor contactors/starters are wired such that when the “phase rotation switch” is in the “A” position the pump motor rotates one direction, and when the “phase rotation switch” is in the “B” position the pump motor rotates in the opposite direction. If the “phase rotation switch” is in the center “O” position, neither motor starter will be energized and the pump will not start.

There is an electrical inlet to connect the “line in” power through the PC-50 drop cable to the control box. There is a twist lock plug to connect the PSC-100P pump power cable to the control box. These connections allow the operator to easily install and remove the cables without the need for special tools.

The primary (460V) side of the transformer is protected by two 1.4-amp fuses and the secondary (120V) side of the transformer is protected by a 1 amp fuse. Fuse details are listed below in the table on the following page.

2.4 Electrical Control Box (CB-xxx-FM) (continued)

The digital flow meter is installed to provide a gross indication of system flow. System flow rate is a gauge for determining change in pressure drop through the filters. Under normal operations a filter would be changed out when system flow rate drops to ~50% of clean filter value.

The digital flow meter uses the frequency of the flow sensor signal for indication of system flow.

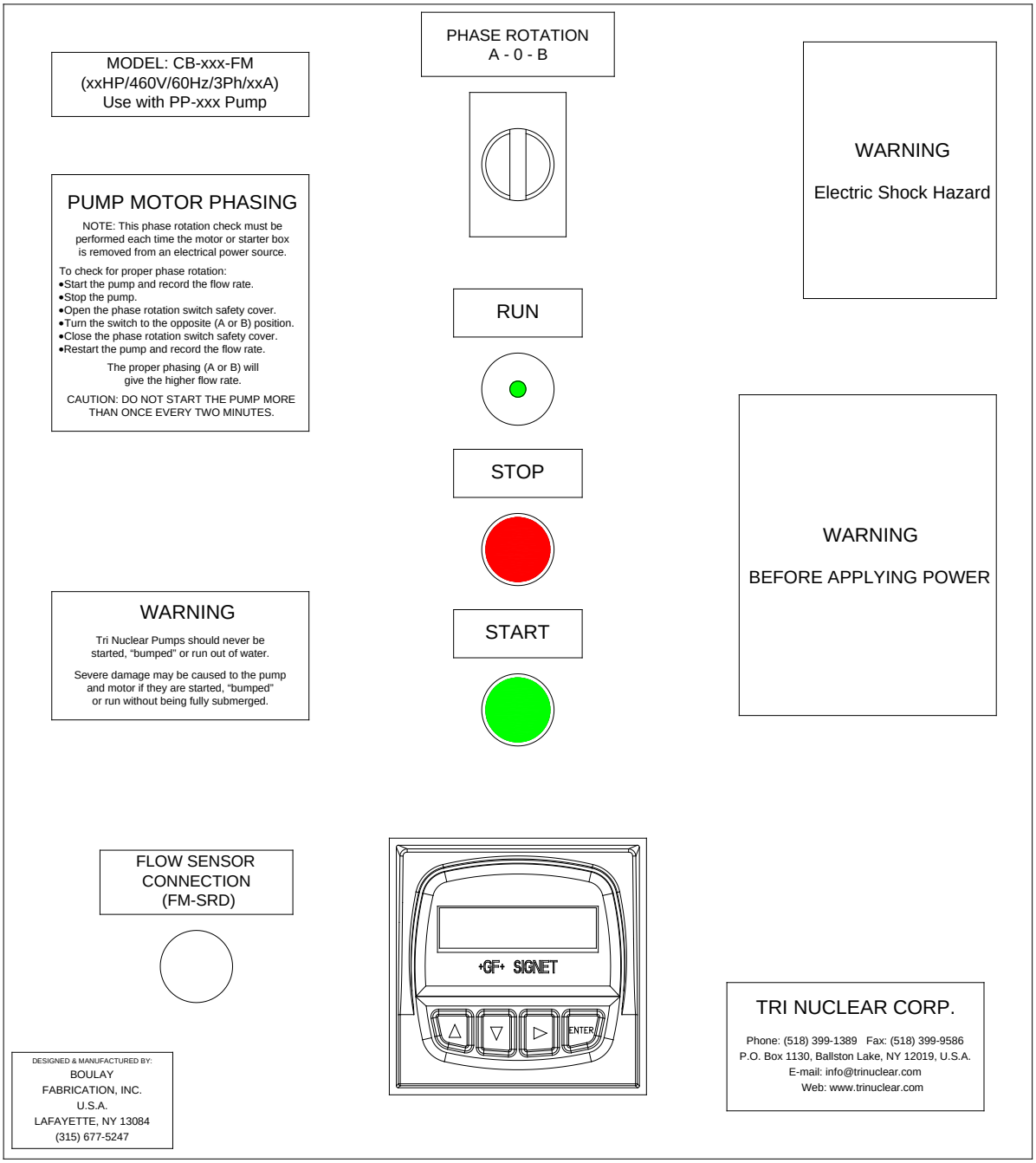
The digital flow meter is powered by a 120V/24DC transformer inside the control box and the flow sensor connects to the meter through an Amphenol connection on the front of the control box.

Advantages of the new digital, integral flow meter/totalizer are:

- It is integral with the pump control box. There is only one piece of equipment to attach to the mounting panel.
- It has solid state components which are not as fragile as the analog meter nor will it go out of calibration if dropped or mishandled.
- It is better protected by being mounted in the control box.
- It has digital readout, a "dial type" digital bar graph with a backlit display for easy viewing.
- No need to stock separate flow meters for separate systems.
- It has a flow totalizer function for logging throughput of the Tri Nuclear system.
- The flow sensor now uses a simple "Amphenol" type connection to connect the flow sensor to the flow meter. This connection does not require any tools to install.

Control Box Ratings / Data	**CB-100P-FM**
For System	SFP-100
Horse Power HP	2-1/2 HP
Overcurrent Trip Set point	3.9 Amps
Voltage / Freq	460V** / 60Hz / 3Ph
Primary Fuse Type / rating / P/N & QTY	Ferraz Shawmut, Amp-trap 2000® ATDR class CC fuse, 1.4 amp, Replacement P/N: ATDR1-4/10, QTY: 2ea installed, 1ea spare
Secondary Fuse Type / rating / P/N & QTY	Littelfuse 3AG fast-acting fuse, 1 amp Replacement P/N: 312001P, QTY: 1ea installed , 1 ea spare
Flow Sensor	FM-SRD
Power Cords	PC-50
Reference Drawing	TNC-018-13

Typical layout of the CB-xxx-FM control box:



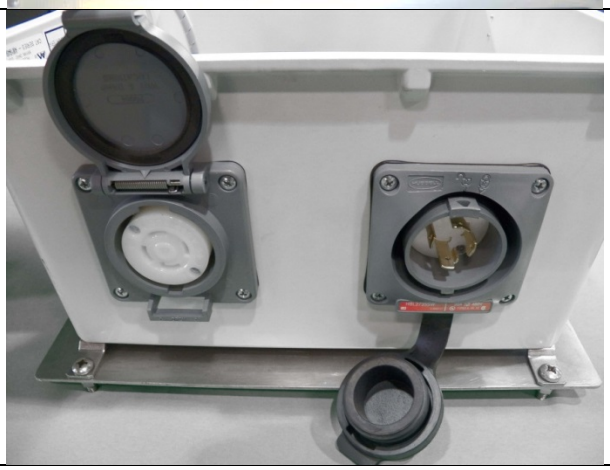
CB-260-FM shown Other models similar. The phase rotation switch has a safety cover to prevent inadvertent actuation. FM-SRD installed. Flow meter indicating 272 gpm. Note the digital "dial" and backlight screen for easy viewing.	
Inside view of a typical CB-xxx-FM control box showing the two motor starters, short circuit / over current trip, 460/120V transformer, 120V/24VDC transformer, fuse blocks and the line in/out twist lock plug terminals.	
Twist lock plugs are located on the bottom of the control box. The plug to the right (with the male twist lock connections) is the line in / power in plug. The plug to the left (with the female twist lock connections) is the power out to the pump.	

Figure 2.3
CB-260-FM Control Box

2.5 Pump Power Cable

The Pump Power cable is non-removable 50ft 12/4 SO cable with a male Nema 4x Twist Lock plug x Sea Con Connector. This Pump Power cable is to supply the pump from the Phase Reversing Control Box.

The Pump Power Cable shown with a male Twist Lock connection.	

Figure 2.5
Pump Power Cable

2.6 Drop Cable (P/N: PC-50)

The PC-50 Control Box Drop Cable is a 50ft 10/4 SO cable with a female twist lock plug x bare wire. This drop cable is to supply the control box from the in plant power source / motor control center / welding outlets etc.

PC-50 Drop Power Cable shown with bare wires on one end and female quick disconnect plug on the other.	

Figure 2.6
PC-50 Drop Cable

2.7 Digital Flow Sensor (P/N: FM-SRD)

The digital flow sensor is a paddlewheel type flow sensor. The paddlewheel has a re-enforced sleeve that covers the titanium shaft and is designed to minimize wear of the rotor. When water flows past the paddlewheel and it rotates, the flow sensor produces a sinusoidal waveform with frequency and amplitude directly proportional to the flow rate. The sensor comes equipped with 100ft of instrument cable with a 90 deg. Amphenol connector to connect to the CB-xxx-FM control box front.

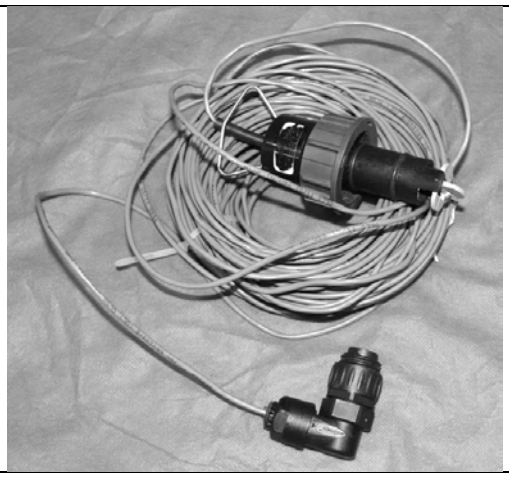
Digital flow sensor P/N: FM-SRD	

Figure 2.7
FM-SRD Digital flow sensor

2.8 Discharge Hose (P/N: PH-2x10)

The SFP-100 comes equipped with one 2in x 10ft hose with male x female cam lock couplers that is connected to the discharge of the PP-100P pump in order to move water away from the unit for better water circulation.

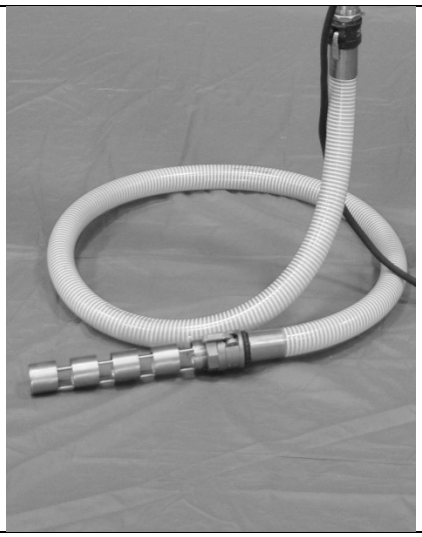
Discharge hose attached to the SFP-100 pump discharge connection	

Figure 2.8
FM-SRD Digital flow sensor

2.9 Tri Nuclear Filter Cartridges

Tri Nuclear Filter Cartridges are designed for inside to outside flow. This keeps major contamination on the inside of the filter cartridge and reduces contamination exposure to workers during filter change out and transfer.

The Polyester filter media has a higher dirt loading capacity than other similar media and results in longer filter runs. It also has a higher resistance to gamma radiation than conventional polypropylene media.

CAUTION	At 10E6 RADS accumulated dose, filter cartridges can start to break down.

Design Data:

Size:	6in dia x 30in long
Flow:	Inside to outside, open top, solid bottom
Media:	Pleated Polyester
Shroud:	18x18 Stainless Steel Mesh
Storage:	Designed for long term underwater storage
Max D/P:	25PSID
Max Flow:	150 GPM per filter
Max Temp:	140F

Filter Cartridge Data					
TNC Part No.	**Cartridge Size**	**Size Rating**	**Media Area**	**Media Type**	**Weight Each**
VCPH-0.1G	0.1 µ (micron)	Nominal	52 Sq. Ft.	Micro Glass	6 lb.
VCPH-0.3PE	0.3 µ (micron)	Nominal	60 Sq. Ft.	Polyester	6 lb.
VCPH-1PE	1.0 µ (micron)	Nominal	62 Sq. Ft.	Polyester	4.21 lb.
VCPH-5PE	5.0 µ (micron)	Nominal	85 Sq. Ft.	Polyester	3.83 lb.
VCPH-10PE	10.0 µ (micron)	Nominal	64 Sq. Ft.	Polyester	4.21 lb.
VCPH-20PE	20.0 µ (micron)	Nominal	64 Sq. Ft.	Polyester	4 lb.

Guidelines for filter selection:

- The 10 micron filter VCPH-10PE is normally chosen for high dirt loading when vacuuming settled particulate.
- The 5 micron filter VCPH-5PE will capture material that might bypass the 10 micron during vacuuming.
- The 1 micron filter VCPH-1PE is excellent for water clarity issues.
- The 0.3 micron VCPH-0.3PE filter is used for “polishing” when water clarity is “a must”.
- The 0.1 micron VCPH-0.1G filter is used when particles bypass the 0.3 micron filter and re-establishing water clarity is needed.

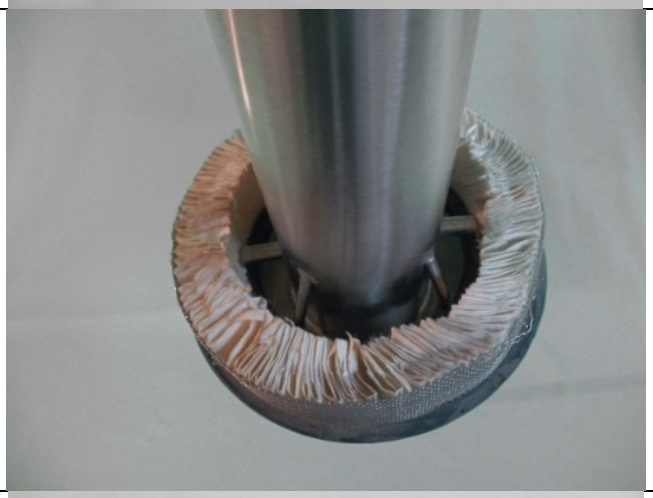
Typical Tri Nuclear Filter Cartridge showing the open top and solid bottom.	
Cut away view of a typical Tri Nuclear Filter Cartridge with the UT-9 Rope Filter Lift Tool engaged.	
Looking into a standard Tri Nuclear Filter Cartridge	

Figure 2.9
Typical Tri Nuclear Filter Cartridge

2.10 Diffuser Pipe (P/N: UT-8A-1.125)

This 2in pipe assembly (2-3/8in diameter x 14inlg.) has an internal 1-1/8in orifice and it is connected to the 2in discharge hose from the PP-100P pump on the SFP-100.

The diffuser and PH-2x10 discharge hose serves two important functions. The first is they minimize the high velocity discharge water exiting the hose and prevents hose-end whipping.

The second function is the hose and diffuser pipe discharge water a sufficient distance away from the SFP-100 to greatly minimize any "upflow" along the skimmer pump, filter tube and buoyancy chambers.

This upflow can disrupt the proper skimmer operation due to the fact it can "short circuit" the water flow at the skimmer skirt interface.

In a typical Rx Cavity or Spent Fuel Pool, this upflow from a SFP-100 operating without a discharge hose and diffuser pipe (P/N: PH-2x10 & UT-8A-1.25) can be difficult to detect unless there is a significant amount of debris on the surface of the water.

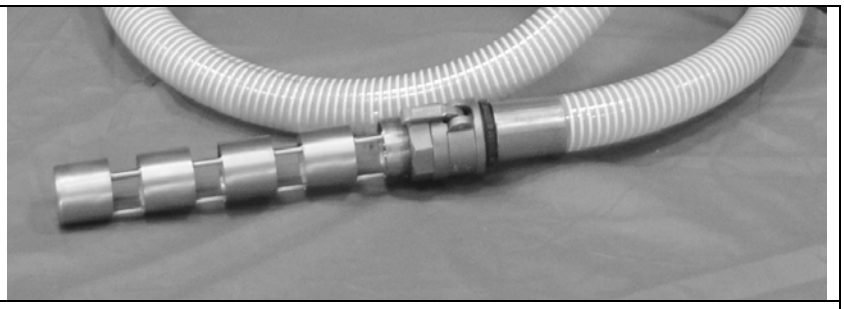
UT-8A-1.125 attached to the end of a 2in hose.	

Figure 2.10
UT-8A-1.125 attached to the a PH-2x10 discharge hose

2.11 Mounting Panel (P/N: UT-10C)

The UT-10C mounting panel allows the control box to be mounted securely to a panel that is designed to hang from a typical hand rail.

CB-260-FM control box mounted on the UT-10C mounting panel. All Tri Nuclear control boxes mount in a similar fashion.	

Figure 2.11
UT-10C Mounting panel

2.12 SFP-100 Gasket (P/N: GS-SFP-100-NP)

A 1/8in thick neoprene gasket is installed between the Filter Tube and Upper Float Chamber.

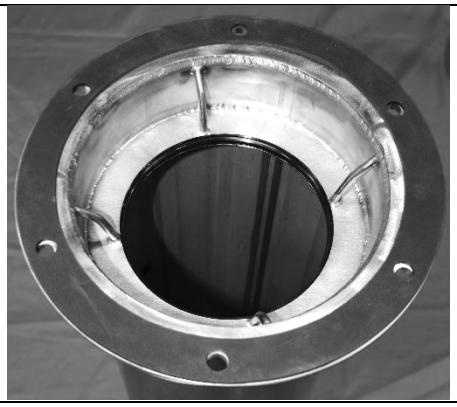
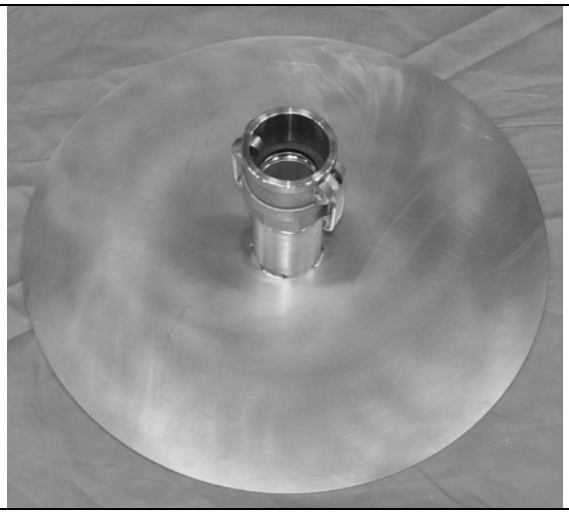
Sealing gasket between the filter tube and the upper float chamber	

Figure 2.12
Gasekt

2.13 Assembly Stand (P/N: AS-2)

A 1/8in thick neoprene gasket is installed between the Filter Tube and Upper Float Chamber.

Assembly Stand for the SFP-100	
Figure 2.13 Assembly Stand	

3.0 Equipment as Shipped

This is a general description of how the equipment is normally shipped. Actual shipments may differ depending on customer shipping requirements.

The SFP-100 is shipped in an unassembled condition in a wooden crate.

Exact packaging is dependent on the qty of the equipment ordered and the method of shipment selected by the end user.

RECEIPT INSPECTION - Carefully inspect the main unit and pump for any shipping damage. Using the Packing List or EGL (Equipment Guide List), verify all material ordered has been received.

4.0 Assembly and Installation in Pool

4.1 Pre Start Up

4.1.1 Mount the CB-xxx-FM control box to the UT-10C mounting panel

4.1.1.1 Remove the control box from its cardboard box. Locate the mounting feet in a bag inside the control box. The bag is taped to the bottom and/or side of the control box with a tag marked “Do Not Discard”.

Install the four (4) mounting feet to the back of the control box with a flat head screwdriver.
.

Figure 4.1.1.1
Mounting feet installed on the back of the CB-600-FM control box
All other CB-xxx-FM control boxes similar.

4.1.1.2 Using a #3 Phillips Screwdriver and a 1/2in open or box end wrench, mount the CB-xxx-FM control box using the four (4) mounting screws, lock washers & nuts (located on the UT-10C mounting panel) assembly on the UT-10D Mounting panel.

CB-xxx-FM control box shown mounted on the UT-10C Mounting panel. All other CB-xxx-FM boxes similar.	

Figure 4.1.1.2
CB-xxx-FM mounted to the UT-10C mounting panel.

4.1.2 Install line in power to the Control Box

After the CB-xxx-FM control box has been mounted to the UT-10C Mounting Panel, attach the PC-50 Drop Cable as shown below:

Connect the bare end of the PC-50 drop cable to an in-plant power supply. Install the PC-50 line in Plug to the CB-xxx-FM control box This will energize the control box and digital flow meter.	

Figure 4.1.2
PC-50 installed to CB-xxx-FM control box

4.1.3 Install the Digital Flow Sensor cable to the control box

After the CB-xxx-FM control box has been mounted to the UT-10C mounting panel, attach the FM-SRD cable to the control box:

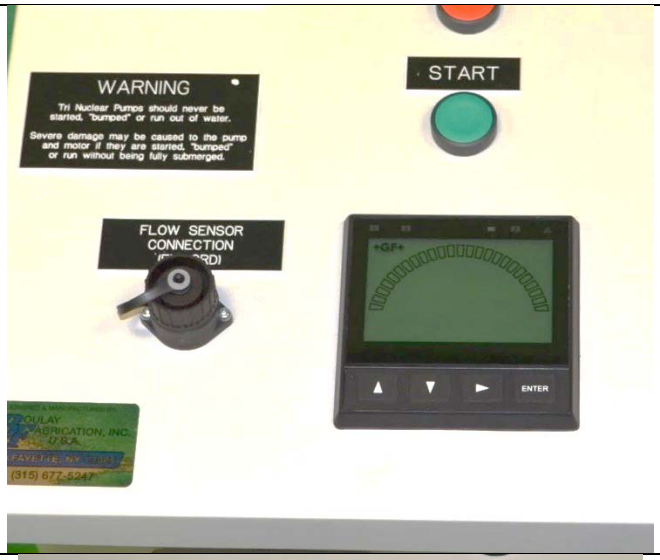
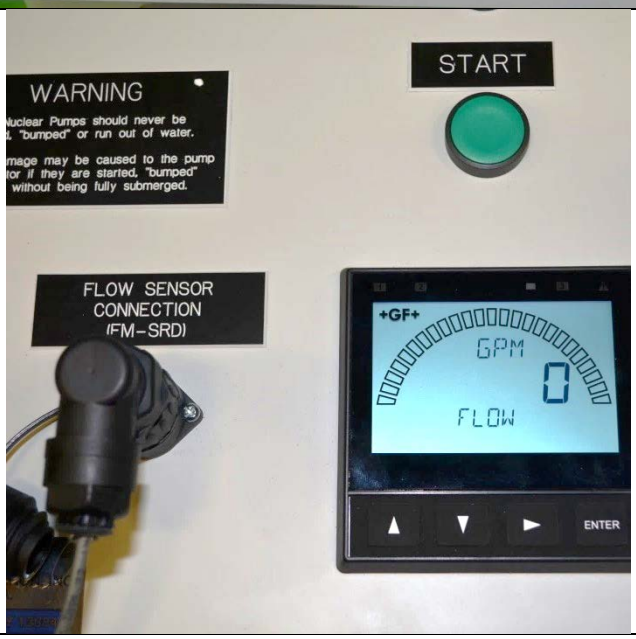
Remove the dust cover for the FM-SRD connection on the front of the CB-xxx-FM control box.	
Install the FM-SRD to the connection on the front of the CB-xxx-FM control box.	

Figure 4.1.3
FM-SRD installed in CB-xxx-FM Control Box

4.1.4 Energize the control box

4.1.4.1 Energize the control box by supplying power to the PC-50 power cable.

4.1.5 Digital Flow Sensor installation in the pump.

NOTICE	**Perform a flow meter check:** - Prior to initial installation - When sensor is replaced - Sensor is suspected to be damaged

4.1.5.1 Prior to installing the flow sensor in the pump, perform a flow meter check by flipping the paddle wheel with a finger to check for dial read-out response. You should be able to achieve 1/2 to full scale deflection by spinning the paddlewheel in either direction.

This is to ensure the flow sensor and digital meter work prior to installing the pump in the water.

FM-SRD prior to installation to a Tri Nuclear pump	
Meter readout showing 260 gpm on the CB-260-FM during the flow sensor check. All other CB-xxx-FM control boxes similar.	

Figure 4.1.5.1
Flow Meter Check

4.1.5.2 Verify the two O-rings are installed on shaft of the Flow Sensor. The flow sensor may not operate properly without the O-rings installed.

4.1.5.3 Prior to installing the flow sensor in the pump, lubricate the O-rings with DI water or other approved lubricant

4.1.5.4 Install the probe into the flow sensor tap making sure the slots in the fitting mate properly with the flow meter sensor orientation pins. The paddle wheel will then be perpendicular to the direction of flow.

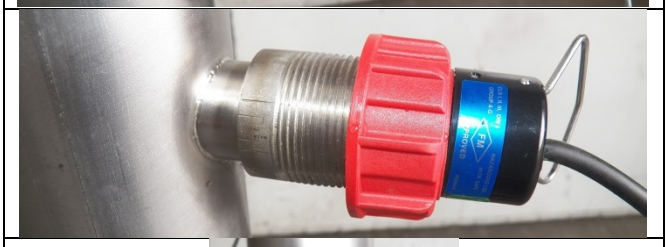
Location of O-rings on the flow sensor.	
 Installation of the flow sensor into the pump.	   

Figure 4.1.5.4
Flow Sensor Installation

4.1.6 Pump Power Cable

The pump power cable is non-detachable from the pump.

4.1.7 Install Pump Power Cables to the Control Box

Attach the PSC-100P power cord to the CB-xxx-FM control box as shown below:

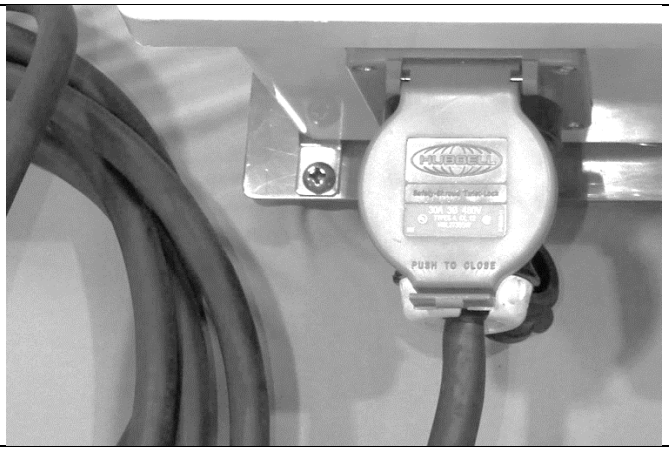
Install the Pump Power Cable Twist Lock Plug to the CB-xxx-FM control box (shown on left) All other control boxes similar.	

Figure 4.1.7
Pump power PSC-100P being installed to a CB-xxx-FM control box.

4.2 Pump Phase Rotation Check

NOTICE	UNLIKE Tri Nuclear Grundfos Pumps, the Prosser Pump may be started (bumped) while out of water to check for proper phase rotation. The "bump" is a start and immediate stop – which will be long enough to determine pump rotation and kick reaction.
	The direction of the pump "START KICK" and "IMPELLER ROTATION" are an integral part of the pump casing and are easily identified.
	If the pump is phased backwards, it WILL trip on overcurrent in a short (< 1 minute) period of time.
	If the pump is phased correctly it you will see 100-150 GPM flow on the Flow Meter. If it is phased backwards, you will see around 75 GPM (if the unit is in the water).

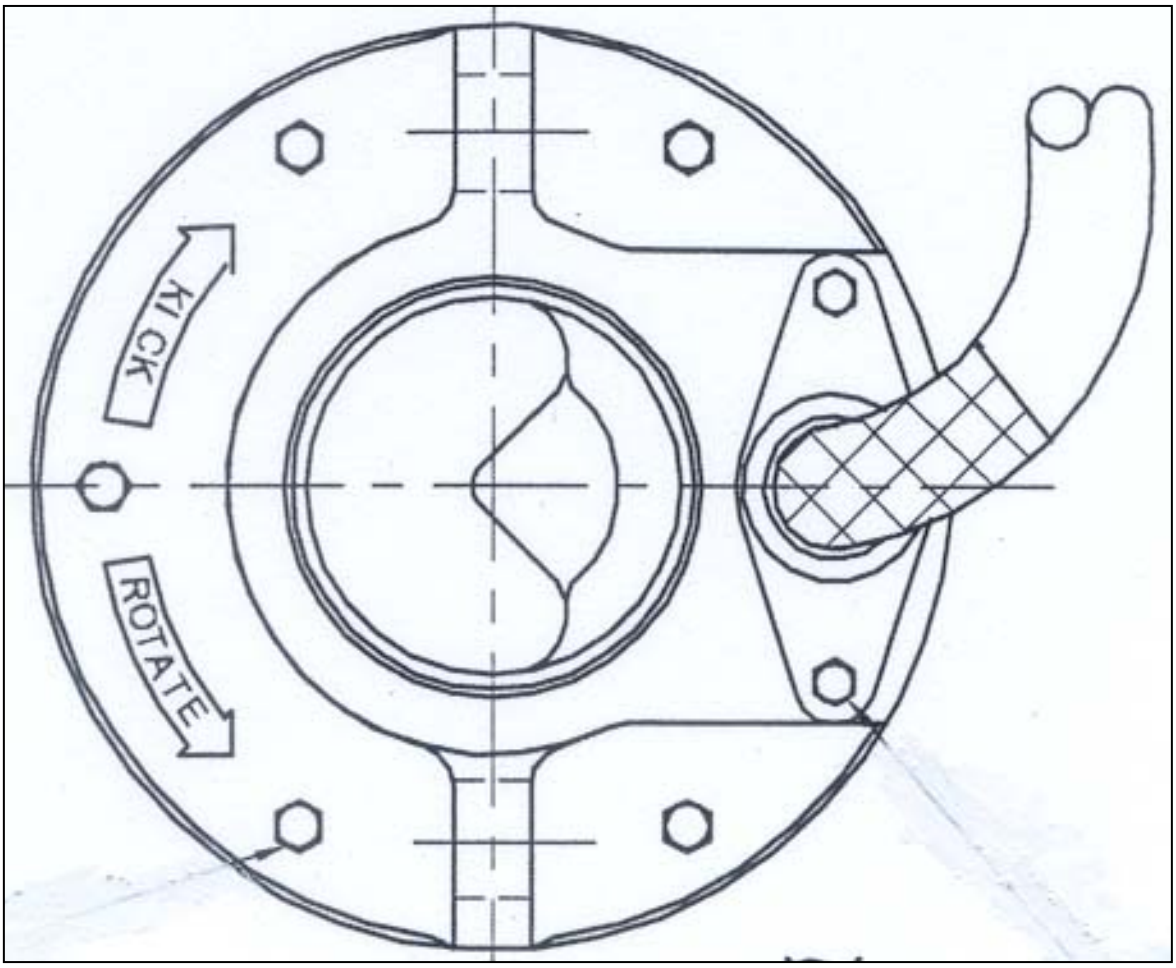
CAUTION	If the pump trips on overcurrent due to being phased backwards, the overcurrent trip must be reset inside the CB-100P-FM control box before restarting. Allow the windings to cool down for at least two (2) minutes prior to restarting.

To check for proper phase rotation of the pump motor, suspend the pump freely by its lift lugs and momentarily start the pump and observe the “KICK”.

The “KICK” should always be in a clockwise direction as viewed from the top of the pump motor housing.

Pump “KICK” is the opposite direction of pump rotation.

To change the phase of the pump, stop the pump (if running), open the safety cover, Turn the switch to the Phase A or B position, close the safety cover, and restart the pump.



4.3 SFP-100 Upper Float Chamber

This sub-assembly consists of the top primary buoyancy float welded with three legs to the overflow trough dished head, and the secondary sealed buoyancy float welded to the underside of the overflow trough. Check the position of the polyester skimmer skirt where it is banded to the OD of the overflow trough dished head; if it has shifted position, refer to section 5.5 of this procedure.

4.4 SFP-100 Assembly

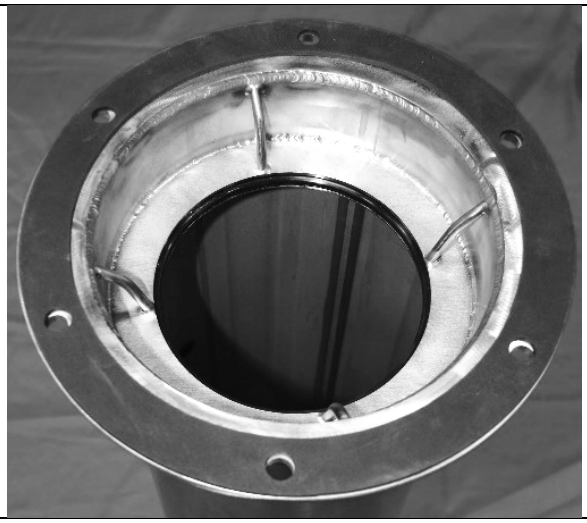
Assembly of the SFP-100 requires the use of an overhead crane.

4.4.1 Place the Assembly Stand (AS-2) on the floor and install the PP-100P pump male camlock fitting into the female camlock on the Assembly Stand.

PP-100P pump installed in the Assembly Stand for the SFP-100	

Figure 4.4.2
Pump on AS-2 assembly stand

4.4.2 Place the 1/8in neoprene gasket on the flange of the SFP-100 Filter Tube. Ensure the holes on the gasket align with the holes on the Filter Tube.

Gasket shown on the top of the SFP-100 Filter Tube	
Figure 4.4.2 Gasekt	

4.4.3 Using an overhead crane, lift the SFP-100 Upper Float Chamber.

Remove the six (6) 7/16in x 3/4in long SS bolts & split lock washers from the bottom mounting flange (they were installed in the bottom mounting flange for shipping purposes). Position SFP-100 Upper Float Chamber on the top of the filter housing & pump assembly.

NOTE: For units purchased prior to 2019:

These two components have mating flanges that require proper orientation. The two flanges should be positioned so that the electric cable tubes through the top float sections are directly in-line with the two (2) rod “U” clips welded to the side of the filter housing.

Install and tighten the six (6) 7/16in x 3/4in long SS bolts & split lock washers. The bolts must be tightened in a “star” pattern. Continue tightening the bolts until all six (6) split lock washers are completely “flat”.

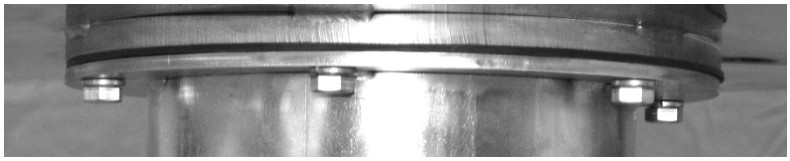
SFP-100 Upper Float Chamber bolted to the Filter Housing	
SFP-100 Upper Float Chamber properly aligned with the Filter Housing “U” clips. This allows for the power cable and flow sensor cable to pass through the Upper float Chamber on units purchased prior to 2019.	

Figure 4.4.3
Upper Float Chamber attached to filter housing

4.4.4 Remove the Victaulic clamp with two bolts from the PP-100P pump (or the SFP-100 Filter Housing) leaving the neoprene gasket on the pump. Using an overhead crane, lift the SFP-100 Upper Float Chamber and attached Filter Housing on top of the submersible pump so the two mating 3in pipe nozzles together.

Slide the neoprene gasket collar equally between the two pipes, but not into the machined groove. The two split collars are now assembled over the gasket and into the two machined pipe grooves. Install and tighten the two coupler bolts/nuts, alternately tightening them to the following torque value: Min – 50 Ft.-Lbs (68 N-m) Max- 60 Ft.-Lbs (80 N-m).

Note: The Victaulic clamp joining the filter housing to the submersible pump is not a rigid type connector. After installing, there will be some flexibility.

Victaulic Gasket on PP-100P pump	
SFP-100 Filter Housing landed on PP-100P pump with gasket pulled over between the two components	
Victaulic clamp installed on the SFP-100 Filter Housing and the PP-100P pump	

Figure 4.4.4
Filter housing attached to pump

4.5 Zip Tie Cables Together

Lay-out the 50 ft. of pump power cable and flow meter cable in a straight line. Tie the two cables together with "zip-ties" every 2 feet starting at the pump end.

Approx. 50 zip-ties are in a small plastic bag in the digital flow sensor meter box. These “zip-ties” are black in color and are made out of polypropylene. They will float if accidentally dropped in the water

Zip Tie and secure the power cable and flow meter cable to the filter tube and the handle on the SFP-100 upper float chamber to tie the cables to the SFP-100 and prevent cable droop around the unit.

4.6 Install the Discharge Hose and Diffuser

If not already installed, attach rigging lines (supplied by purchaser) to the two centered lifting fixtures found on the SFP-100 upper float chamber. Raise the SFP-100 and remove the AS-2 Assembly Stand from the discharge of the pump.

CAUTION	The AS-2 Assembly Stand must be removed from the discharge of the pump prior to lowering into the Rx Cavity or Spent Fuel Pool. If the AS-2 is not removed, the SFP-100 will not operate properly and severe damage to the pump may occur due to running it without water and / or running it at shutoff head.

4.6.1 Attach the PH-2x10 hose and diffuser to the pump discharge.

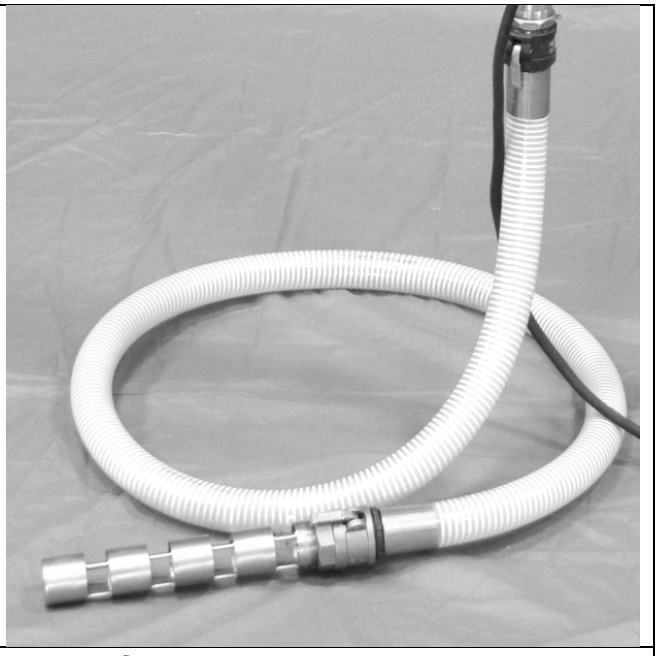
Discharge hose attached to the SFP-100	

Figure 4.6.1
Hose and diffuser attached to SFP-100 pump

4.7 Installing the unit in the water.

DANGER	Do not submerge the control box for any reason.
CAUTION	Do NOT use the electrical cables to lift the pump out of the water.
NOTICE	Running the unit without hoses will not produce desired results in surface water filtration.

4.7.1 After all the steps of 4.1 through 4.6 have been completed, lower the assembled SFP-100 into the cavity or spent fuel pool water.

5.0 Operations

5.1 Initial addition of ballast water

5.1.1 Ballast water initially must be added to the SFP-100 Upper Float Chamber through the top 3/4in male camlock connection in order to adjust the floating level of the unit for proper operation. Once the unit is at the proper level, the skimmer skirt will automatically adjust the overflow to maintain a minimum skimming water thickness as the flow rate varies with the gradual buildup of dirt on the filters.

5.1.2 With the filter pump SHUT OFF, add water to the SFP-100 Upper Float Chamber until the water level is approximately even with the **circumferential weld of the upper dished head.** Depending the temperature of the water, the boric acid content, etc., added ballast water will normally vary between 0 to 3 gallons to achieve the proper floating level of the skimmer.

5.1.3 Reinstall the 3/4in camlock cap in the top of the SFP-100 Upper Float Chamber; the skimmer is now ready for start-up.

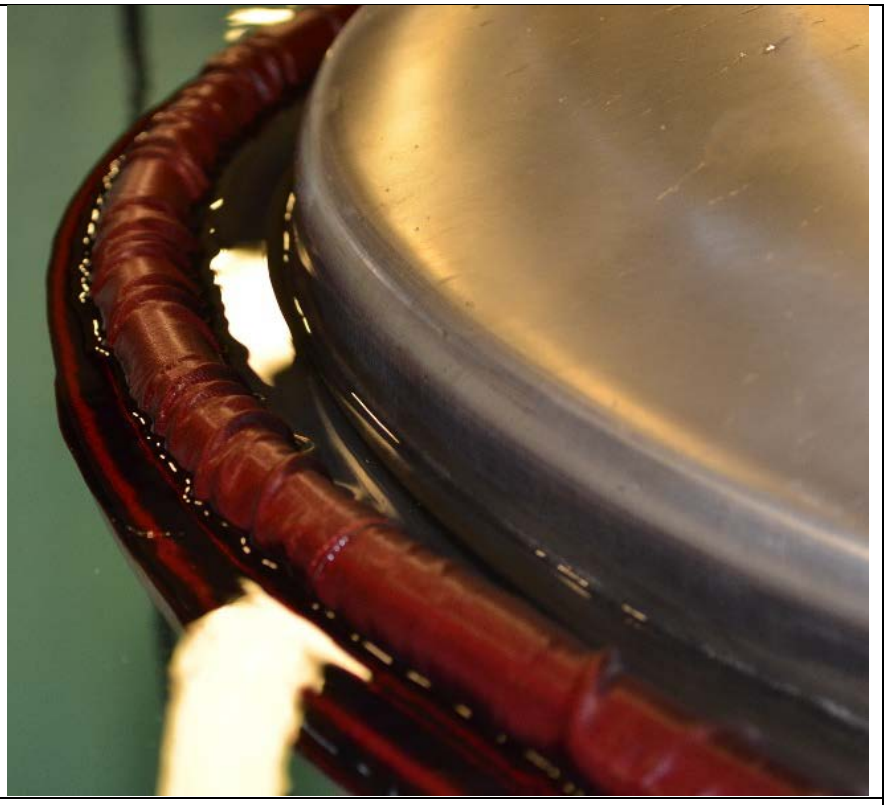
Water level shown at the weld line of the upper dished head	

Figure 5.1.3
SFP-100 head water level

5.2 Filter Installation

NOTICE	Filter cartridges can take several minutes to flood while trying to submerge them in the pool. The flooding time can be minimized by pre-soaking the filters

5.2.1 Select the proper filter cartridge size based on the information in section 2.9.

5.2.2 Install a new filter cartridge in the SFP-100 using the UT-9 Rope Filter Lift tool. See OI-6 for detailed instructions on operating the UT-9 Rope Filter Lift Tool.

		
UT-9 being lowered into a filter cartridge	UT-9 partially installed in a filter cartridge	Filter cartridge attached to the UT-9 Rope Filter Lift Tool.

5.3 Initial Startup

5.3.1 Verify all the steps in section 4.0 through 5.1 have been completed prior to startup in section 5.3.

5.3.2 Start the pump.

The skimmer will begin to overflow and start the skimming operation.

Note that the water level and floating skirt ring will drop slightly in the trough when the pump first starts. The skimmer body will rise slightly and float a little higher in the water. This is normal during startup and will settle out and you will see a thin skim across the skimmer skirt.

5.3.3 If the skimmer rises too high in the pool and water does not spill into the overflow trough, or the skimmer continues to rise up out of the water, this usually indicates insufficient ballast water has been added to the SFP-100 upper float chamber. Recheck Section 5.1 above.

5.3.4 The skimmer skirt is designed to self-adjust to the flow in the SFP-100. There should be thin skim around the SFP-100 that does not cause significant surface ripples in the pool.

5.4 Normal Operation

5.4.1 As the filter cartridge starts to load up from dirt buildup with extended operations, the flow will decrease through the skimmer. This will not significantly affect the skimming efficiency of the unit, since it is designed for a flow rate of between 50 and 150 GPM. The skirt float ring will automatically adjust its level to the flow rate and maintain an efficient thin overflow stream.

5.4.2 The dose rate on the filter should be periodically and carefully monitored for radiation levels, since floating crud caught by the skimmer can cause high dose rate levels on the filter cartridges or the skimmer skirt itself.

Normally, filters are changed out when at a pre-determined dose rate OR when the flow rate drops to approximately 1/2 of the clean condition flow rate.

5.5 Skimmer Skirt replacement

If the skimmer skirt is damaged due to ripping or if it has been exposed to high contamination levels or high dose rates, it may be necessary to replace the skirt.

5.5.1 Remove and dispose of damaged/contaminated skirt by loosening the screw clamp band that holds the skirt in place.

Figure 5.5.1
SFP-100 with the Skimmer Skirt removed

5.5.2 Ensure the edge of the skimmer trough is smooth with no rough/sharp edges. With two people, place the new skimmer skirt in the skimmer trough so that the floatation tube portion is on the inside of the skimmer trough with the excess material from the skirt is hanging over the edge of the overflow trough (as seen below).

Figure 5.5.2
SFP-100 with the Skimmer Skirt shown pulled over the overflow trough

Note: Ensure that the hem on the Skimmer Skirt is facing out.

5.5.3 Obtain the 1/2" x (approx.) 115" stainless steel screw clamp band to hold the skirt in place. Place the band on the skimmer overflow trough so that the sharp edges are facing out and tighten to just snug.

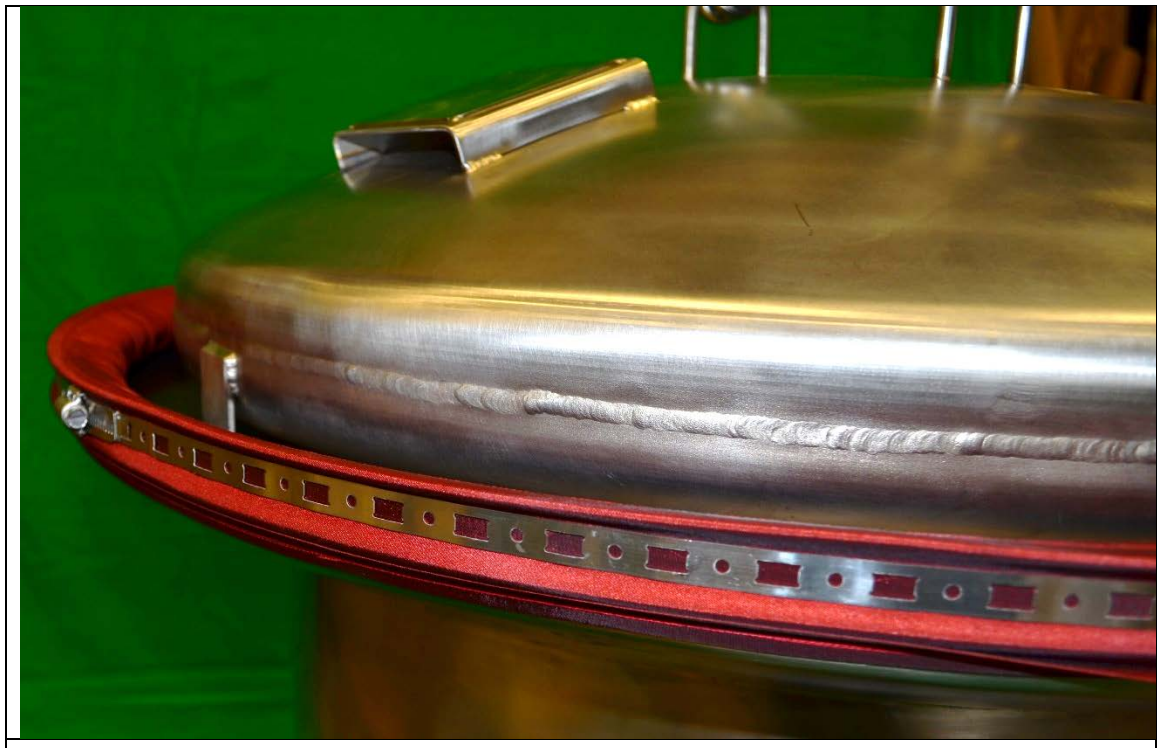


Figure 5.5.3
SFP-100 with the Skimmer Skirt band installed

Note: Ensure that the stainless steel band is up against the lip of the overflow trough.

5.5.4 Carefully pull the skirt up so that the edge of the skirt hem catches the band. See Photo below.

Figure 5.5.4
SFP-100 with the Skimmer Skirt band installed

Tighten band using the screw clamp. The floatation tube should have freedom to move up and down uniformly within the skimmer trough.

6.0 Storage Requirements

CAUTION	Caution should be taken to ***NOT*** store any plastic components (eg. filters or hoses) near high radiation fields associated with equipment such as fuel bundles, LPRM's or control blades. Breakdown of such components can occur with accumulated exposures of 10E6 Rad. For this reason, precautions should be taken to minimize accumulative dose for the following components: suction hose, filter cartridges, power and instrument cable, flow sensor, and electric motor. All components are chemically suitable for long term storage in the fuel pool cavity environment.

6.1 The preferred method of storing the submersible pump assembly when not in use is underwater. If stored out of water, the skimmer should not be stored in freezing temperatures.

7.0 Maintenance

There is no required periodic maintenance required for Tri Nuclear SFP-100.

7.1 Tube Sheet O-Ring replacement

If the Tube Sheet o-ring becomes damaged, it can be replaced.

7.1.1 Remove the old O-ring and ensure the O-ring groove is clean and free of any material that may have been left behind from the old O-ring.

7.1.2 Obtain a tube sheet O-ring, and inspect for cuts and nicks. Clean the O-ring prior to installation.

7.1.3 Run a bead of glue around the tube sheet seating surface after cleaning surfaces thoroughly.

7.1.4 Install O-ring and maintain a constant pressure for approximately 20 seconds.

7.1.5 Verify O-ring is properly mounted by attempting to remove it using a reasonable force.

7.1.6 Install a standard Tri Nuclear filter cartridge and check for proper seating on the O-ring.

8.0 Troubleshooting

See OI-5 UFV Grundfos Pump Troubleshooting Procedure for troubleshooting the CB-100P-FM control box.

8.1 Troubleshooting charts

8.1.1 PP-100P Troubleshooting Chart

TROUBLE SHOOTING		
CAUTION ! Always disconnect the pump from the electrical power source before handling. If the system fails to operate properly, carefully read instructions and perform maintenance recommendations. If operating problems persist, the following chart may be of assistance in identifying and correcting them: **MATCH "CAUSE" NUMBER WITH CORRELATING "CORRECTION" NUMBER.** **NOTE:** Not all problems and corrections will apply to each pump model.		
PROBLEM	**CAUSE**	**CORRECTION**
Pump will not run	1. Poor electrical connection, blown fuse, tripped breaker or other interruption of power, improper power supply. 2. Motor or switch inoperative (to isolate cause, go to manual operation of pump). 2c. Defective motor 3. Insufficient liquid level.	1. Check all electrical connections for security. Have electrician measure current in motor leads, if current is within ±20% of locked rotor Amps, impeller is probably locked. If current is 0, overload may be tripped. Remove power, allow pump to cool, then recheck current. 2c. Check winding insulation (Megger Test) and winding resistance. If check is outside of range, dry and recheck. If still defective, replace per service instructions. 5. Check discharge line for restrictions. 8. Check impeller for freedom of operation, security and condition. Clean impeller and inlet of any obstruction. 10. Check phase rotation per section 4.2
Pump hums but does not run	1. Incorrect voltage 8. Impeller jammed or loose on shaft, worn or damaged, impeller cavity or inlet plugged.	
Pump delivers insufficient capacity	1. Incorrect voltage. 5. Discharge restricted. 8. Impeller jammed or loose on shaft, worn or damaged, impeller cavity or inlet plugged. 10. Pump running backwards	
Pump operates noisily or vibrates excessively	2c. Worn bearings, motor shaft bent. 5. Debris in impeller cavity or broken impeller 10. Pump running backwards	

8.2 Insulation Resistance

8.2.1 Cable & Control:

Use the megger to measure the insulation resistance. Attach the megger probes to the pump lead side of the circuit breaker in the control box, one probe to the ground lead and one probe to a pump power lead. Acceptable values of insulation resistance are 10 megohms or greater. If insulation resistance is below 10 megohms, the motor leads should be disconnected from the cable assembly so that the cable and motor can be tested separately.

Should the cable show insulation resistance of less than 10 megohms, disconnect from control box and attach megger probes to the individual leads within the cable. Values below 10 megohms of insulation resistance would indicate damage or moisture and cable should be replaced. Low values of insulation resistance below 10 megohms for the circuitry within the control box would indicate damage or moisture, Any bad parts should be replaced.

8.2.2 Motor:

The insulation resistance of the motor stator can be measured by attaching one probe of the megger to the motor power leads and the other probe to the motor ground lead or to bare metal of the pump frame. Insulation resistance values under 10 megohms would indicate presence of excessive moisture within the stator winding.

Another test of the electrical integrity of the stator is the measurement of winding resistance with an ohmmeter. Such measurement is made between the leads of the stator. If the resistance of the stator winding is greater than listed below.

Pump Type	HP	Volt	Hz	NEMA Start Code	Amperage Full Load	Amperage Locked Rotor	Nominal Line to Line Resistance Blk–Yel Yel–Red Blk - Red
PP-100P	2.5	460	60	J	3.9	24.6	8.0 - 8.0 - 8.0

9.0 Replacement Parts

Below is a listing of **Recommended Spare Parts for the SFP-100:**

Qty	Part No.	Description
1	PP-100P-SFP	Replacement SFP-100 pump and accessories. Includes (1) Prosser style pump with Discharge Nipple and SS Victaulic Clamp, 2-1/2HP/460V/3Ph/60Hz, CB-100P-FM PHASE REVERSING control box with twist lock plugs and integral 0-200 GPM digital flow meter, FM-SRD Digital Flow Sensor, 50' of non-removable power cable with twist lock plug and PC-50 drop cable with twist lock plug, (1) PH-2x10 discharge hose (1) UT-8A-1.125 diffuser with 1-1/8" diffuser and AS-2 Assembly Stand.
1	SK-S	Skimmer Skirt and stainless steel clamp
1	GS-SFP-100-NP	1/8in thick Neoprene for sealing the Filter Tube and the SFP-100 Upper Float Chamber.
1	UT-8A-1.125	2in Diffuser pipe assembly x 14"lg. with an internal 1-1/8in orifice
1	O-Ring	O-ring for filter tube sheet
1	CB-100P-FM	2-1/2 HP/460V/3Ph/60 Hz phase reversing control box with twist lock plugs and integral 0-200 gpm digital flow meter. Includes FM-SRD digital flow sensor.
1	PC-50	PC-50 drop cable with female plug (50ft Cable w/ female connector)
1	FM-SRD	Flow sensor with reinforced paddlewheel and 100ft cable with Amphenol connector.
1	PH-2x10	2in x 10ft lg hose with Polypro MxF camlock couplers
AR	VCPH-0.1G	Filter Cartridge, 0.1 micron, 52ft^2 microglass, media, 6in x 30in lg, 6ea/cs
AR	VCPH-0.3PE	Filter cartridge, 0.3 micron, 60 ft^2 polyester media, 6in x 30in lg, 6ea/cs
AR	VCPH-1PE	Filter cartridge, 1 micron, 62 ft^2 polyester media, 6in x 30in lg, 6ea/cs
AR	VCPH-5PE	Filter cartridge, 5 micron, 85 ft^2 polyester media, 6in x 30in lg, 6ea/cs
AR	VCPH-10PE	Filter cartridge, 10 micron, 64 ft^2 polyester media, 6in x 30in lg, 6ea/cs

10.0 ADDITIONAL INFORMATION

For additional information, or if special problems develop, please contact:

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Tri Nuclear Corp.
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Fx. 518-399-9586
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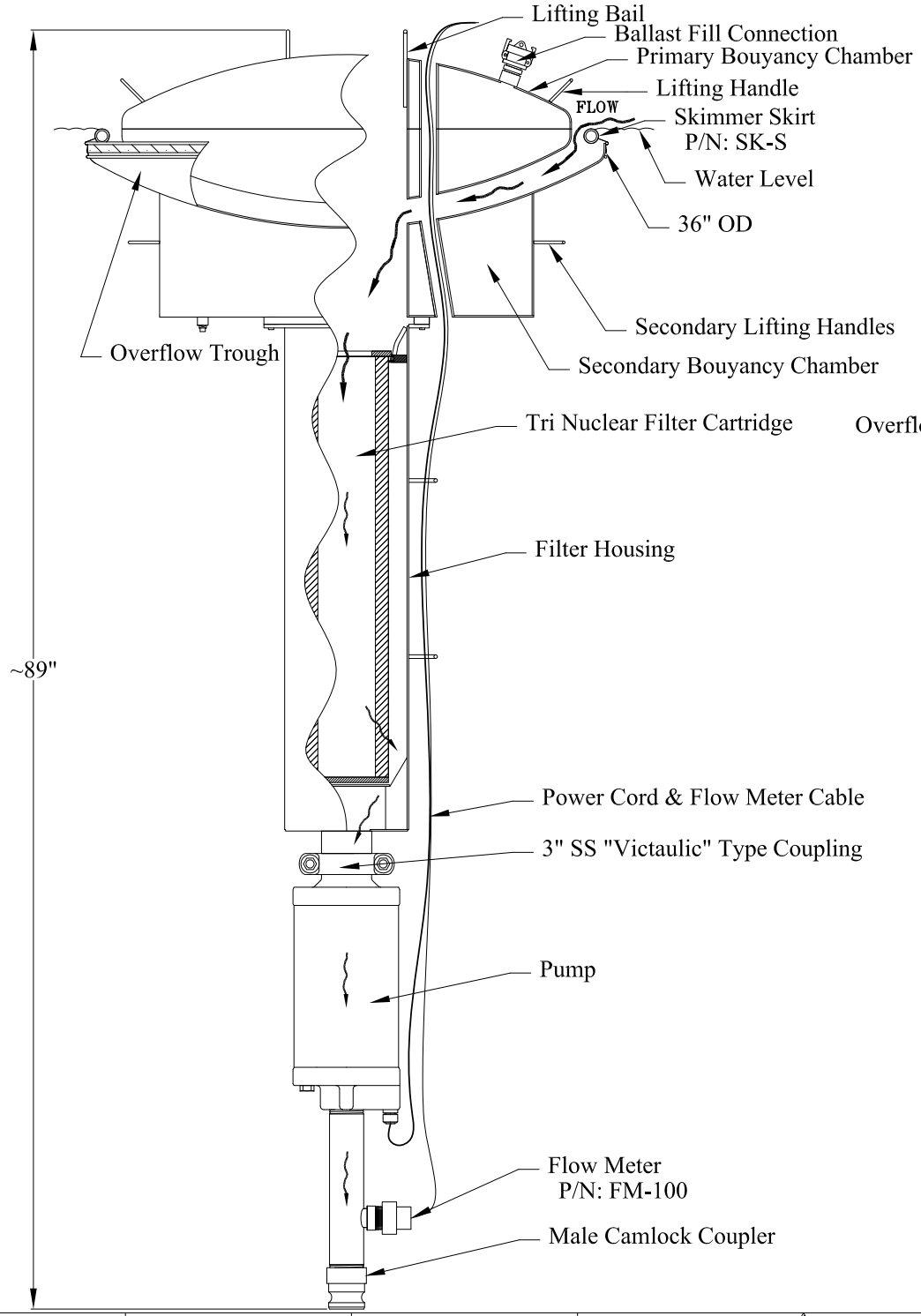
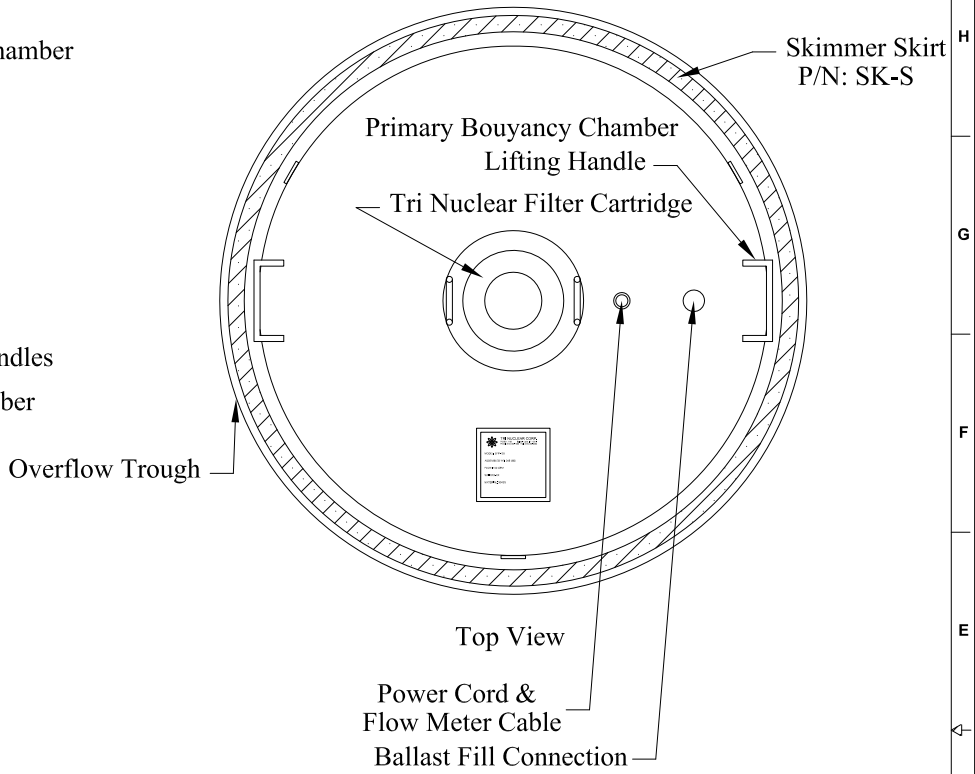
www.trinuclear.com
e-mail: rick@trinuclear.com





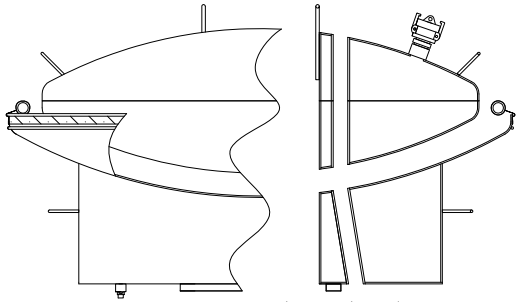
General Specifications:

- Designed for Skimming Water Surface
- 100 GPM, 1 Filter Unit
- Power Requirements: 2-1/2HP, 460V, 3 PH, 60 Hz, 3.9A
- All Material - Stainless Steel except Aluminum Pump
- System Operation: Negative Pressure
- Empty Weight (Including Pump): 245 lb.
- Weight Full of Water (Including Pump): 440 lb.
- Zip Tie Power Cord & Flow Meter Cable to Lifting Bail
- Pump with Non-Removable Power Cord
- Single Tri Nuclear Filter Cartridge

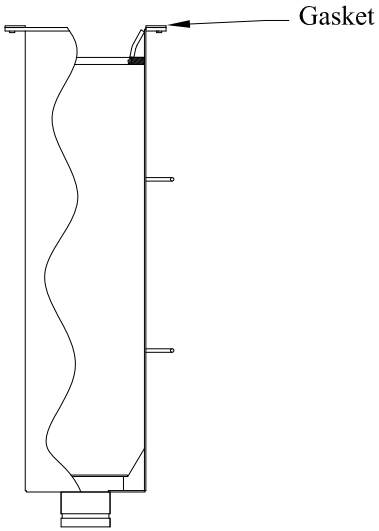
Tri Nuclear Corp.
P.O. Box 1130, Ballston Lake, NY 12019

Skimmer / Filter / Pump Unit

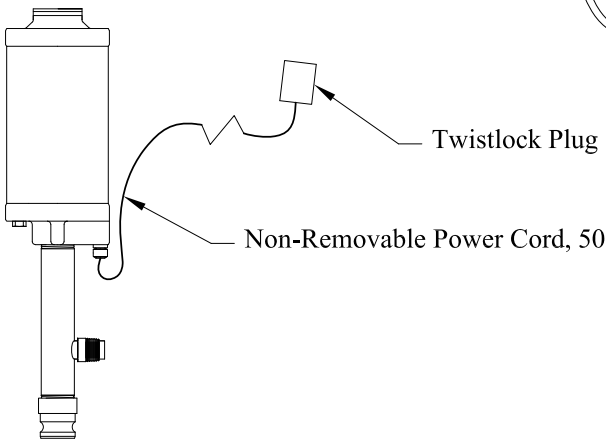
Model No. SFP-100	Rev. Rick Russell Date 08/25/17	Brochure	
Dwg. TNC-017-02	Apv'd James L. Warden Date 08/30/17	Rev. F	Page 1 of 2



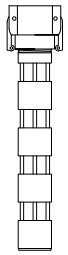
SFP-100 Upper Float Chamber



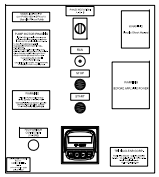
SFP-100 Filter Housing



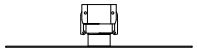
SFP-100 Pump & Discharge Nipple



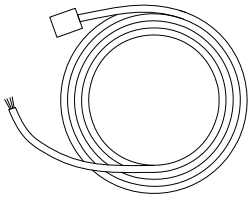
UT-8A-1.125
2" Diffuser with
1-1/8" Orifice



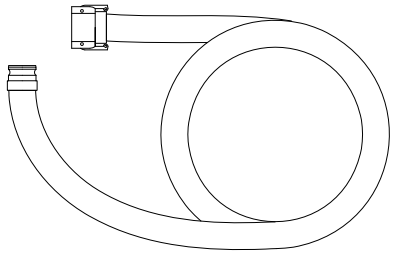
CB-100P-FM
Phase Reversing Control Box
with Integral Flow Meter



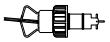
AS-2 Assembly Stand



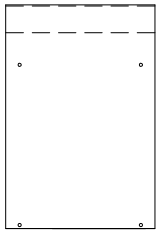
PC-50 Drop Cable



PH-2x10 Discharge Hose



FM-SRD Flow Sensor



UT-10C Mounting Panel

NOTE:

All Items Shown come with the SFP-100.

Tri Nuclear Corp.
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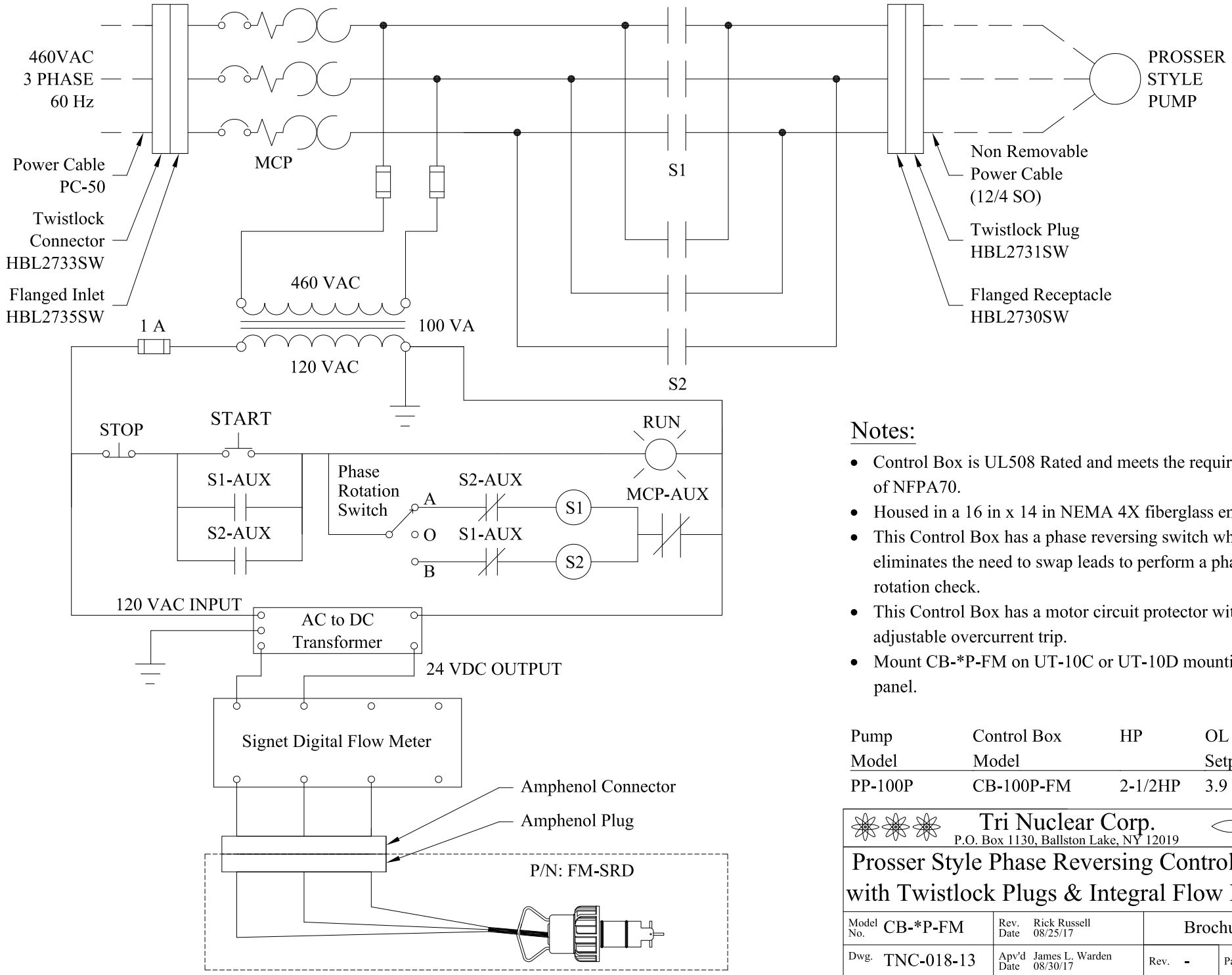
SFP-100 System
Part Identification

Model No.	Dwg.	Rev.	Page
SFP-100	TNC-017-02	F	2 of 2



Notes:

- Control Box is UL508 Rated and meets the requirements of NFPA70.
- Housed in a 16 in x 14 in NEMA 4X fiberglass enclosure.
- This Control Box has a phase reversing switch which eliminates the need to swap leads to perform a phase rotation check.
- This Control Box has a motor circuit protector with an adjustable overcurrent trip.
- Mount CB-*P-FM on UT-10C or UT-10D mounting panel.

Pump Model	Control Box Model	HP	OL Trip Setpoint
PP-100P	CB-100P-FM	2-1/2HP	3.9 amps

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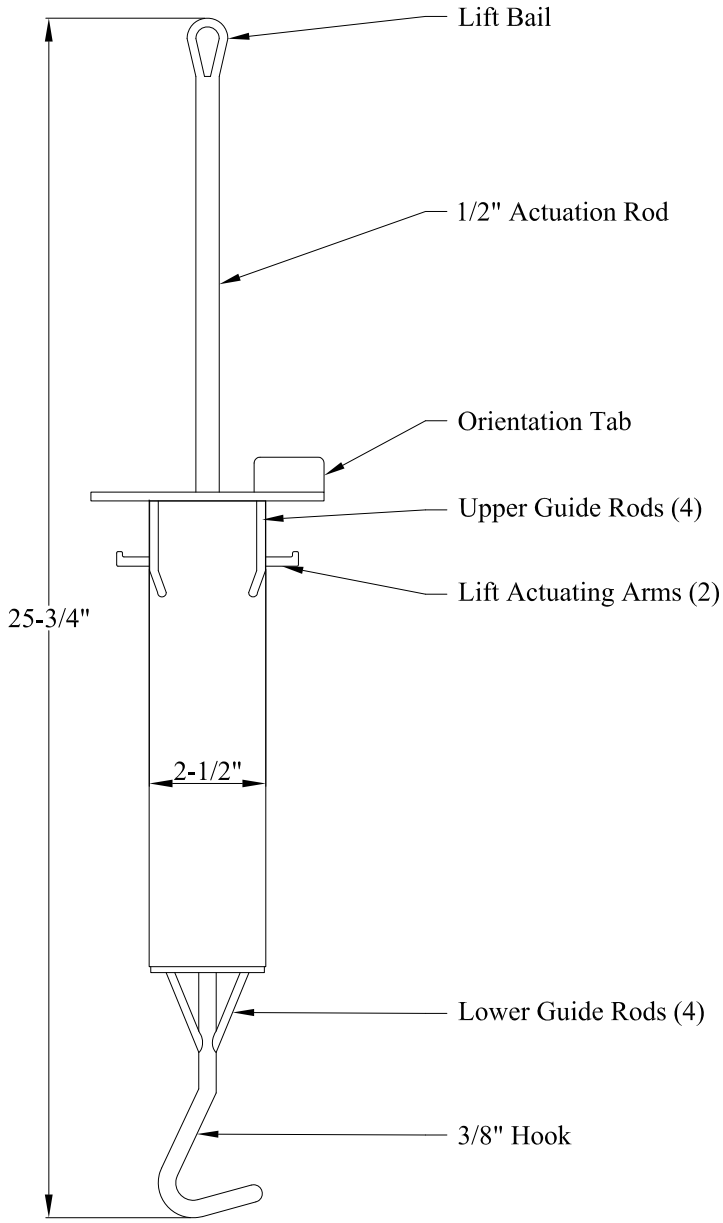
Prosser Style Phase Reversing Control Box with Twistlock Plugs & Integral Flow Meter

Model No. CB-*P-FM	Rev. Rick Russell Date 08/25/17	Brochure	
Dwg. TNC-018-13	Apv'd James L. Warden Date 08/30/17	Rev. -	Page 1 of 1



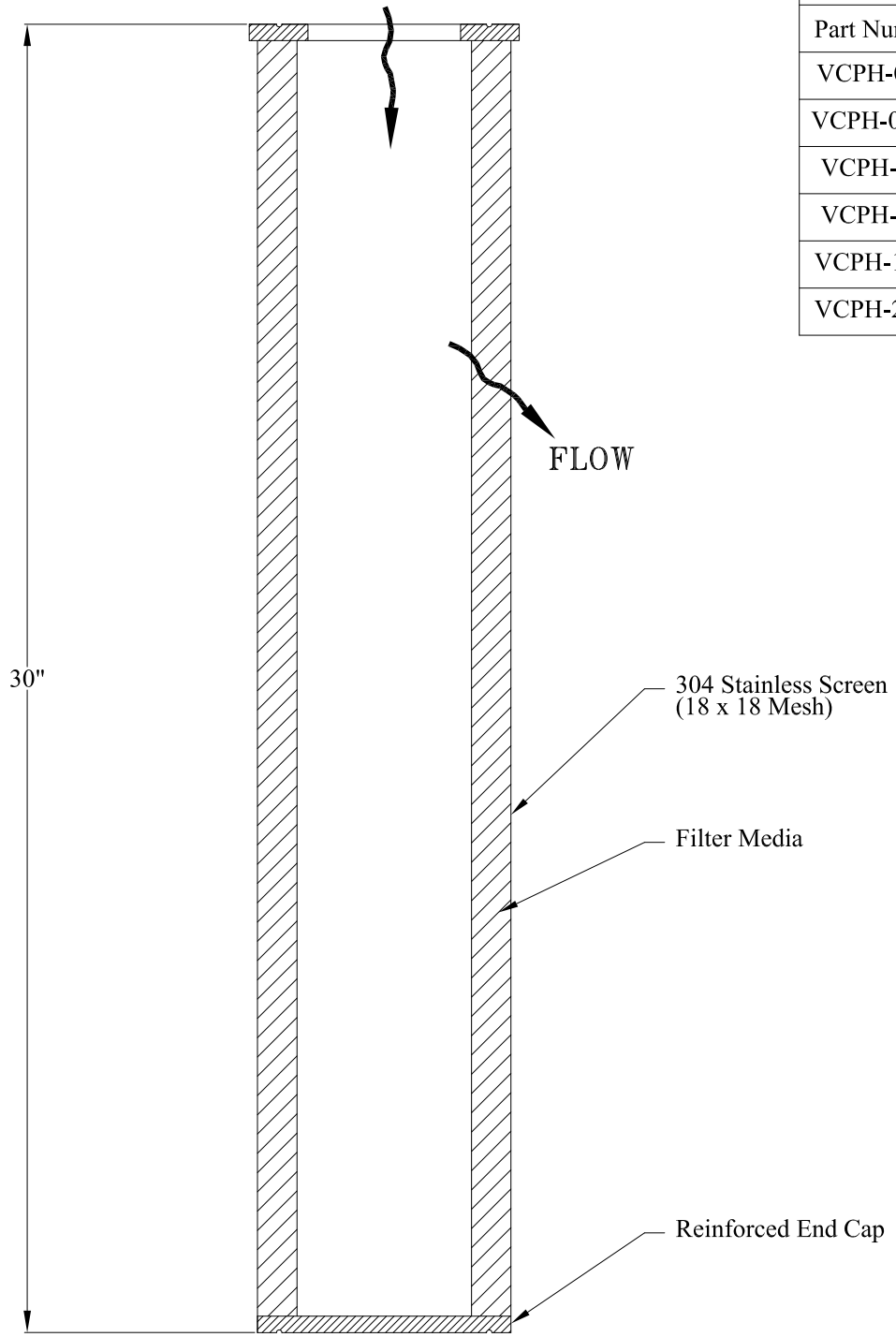
General Specifications:

- Designed for Remote Grapple & Transport of Tri Nuclear Filter Cartridges Underwater or Out of Pool
- All Material - Stainless Steel
- Orientation Tab - To Show Open Side of Hook When Viewed from Above.
- Centering Rods - To Guide Tool into Filter Cartridge
- Hook - To Open Filter Housing Swing Cover
- Lift Bail - To Attach Rope or UT-15 Utility Chain
- Lift Arms - To Positively Latch onto Filter Cartridge
- Dimensions: 5" Dia. x 17-3/4" Fully Retracted
- Dimensions: 5" Dia. x 25-3/4" Fully Extended
- Weight: 6 Lbs.

Tri Nuclear Corp.
P.O. Box 1130, Ballston Lake, NY 12019

Rope Filter Lift Tool
UT-9

Model No. UT-9	Drawn Rick Russell Date 07/02/14	Brochure	
Dwg. TNC-014-19	Apv'd James L. Warden Date 07/02/14	Rev. -	Page 1 of 1



Filter Cartridge Data

Part Number	Cartridge Size	Size Rating	Media Area	Media Type	Weight Each
VCPH-0.1G	0.1 μ (micron)	Nominal	52 Sq. Ft.	Micro Glass	4.5 Lbs.
VCPH-0.3PE	0.3 μ (micron)	Nominal	60 Sq. Ft.	Polyester	5.5 Lbs.
VCPH-1PE	1 μ (micron)	Nominal	62 Sq. Ft.	Polyester	4.5 Lbs.
VCPH-5PE	5 μ (micron)	Nominal	85 Sq. Ft.	Polyester	4.0 Lbs.
VCPH-10PE	10 μ (micron)	Nominal	64 Sq. Ft.	Polyester	4.0 Lbs.
VCPH-20PE	20 μ (micron)	Nominal	64 Sq. Ft.	Polyester	3.0 Lbs.

General Specifications:

- Size: 6" Diameter x 30" Long, Open Top, Solid Bottom
- Max Flow Rate per Filter: 150 GPM
- Max Operating Differential Pressure: 25 psid
- Max Operating Temperature: 140 °F
- Application: For all Tri Nuclear equipment used in PWR/BWR Plants.
- Designed for Inside to Outside Flow (Retains Crud)
- May be stored in Filter Storage Racks
- To be used with Tri Nuclear Rope Filter Lift Tool for remote grapple and transport.
- Packaged & Sold: Six Cartridges in a cardboard case.

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Standard Tri Nuclear
Filter Cartridge

Model No. VCPH-*	Rev. Rick Russell Date 01/08/15	Brochure	
Dwg. TNC-019-02	Apv'd James L. Warden Date 01/08/15	Rev. B	Page 1 of 1