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# Building Automation System (BAS) Utilized for Environmental Monitoring

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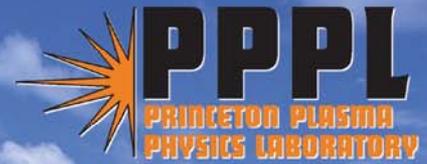
Princeton, New Jersey





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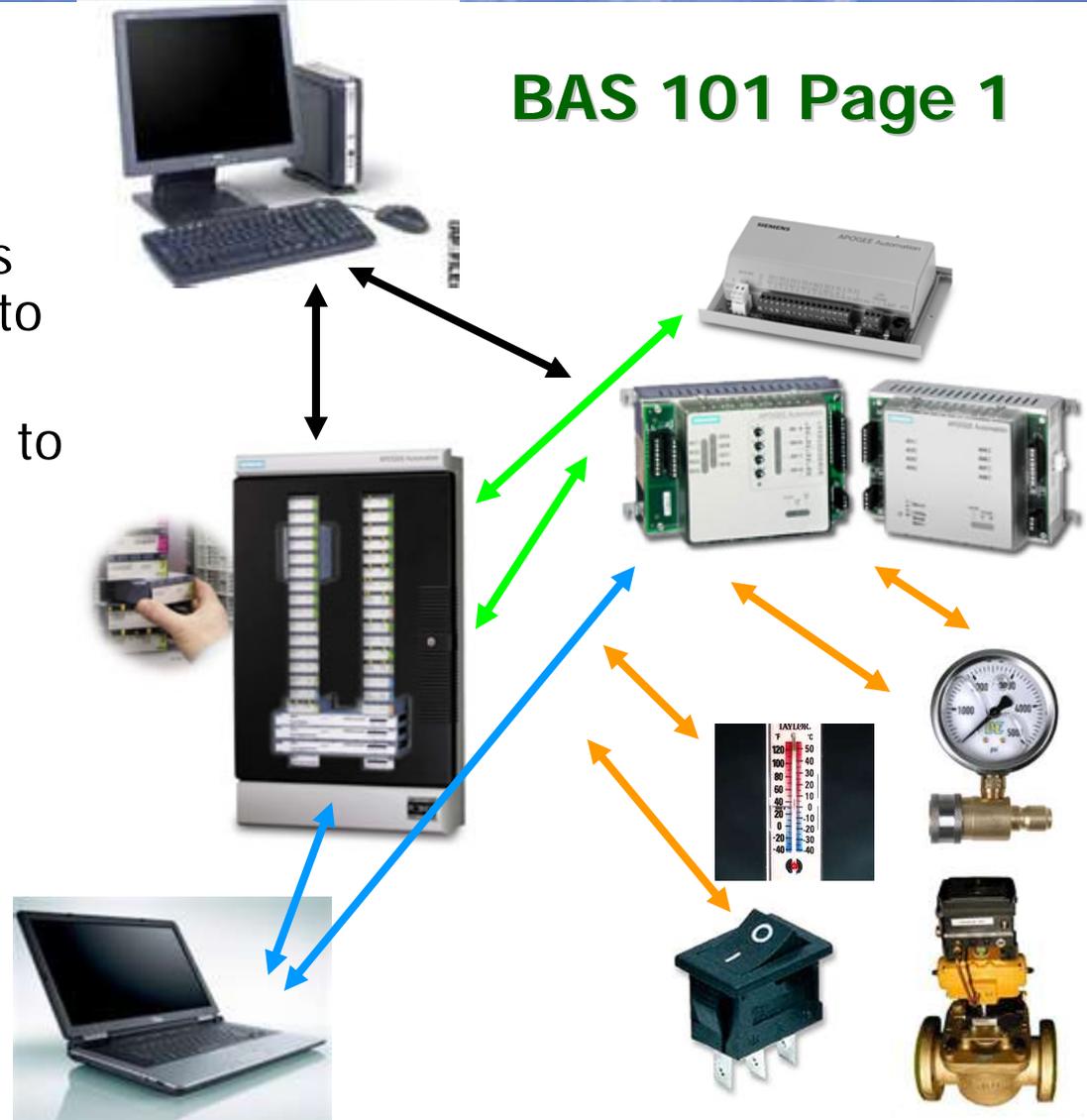
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## Any BAS has:

- Front end server, control software, & data storage
- Modular Building Controllers are Field Panels connected to the server
- Local Controllers connected to the Field Panels
- Input Sensors & Output devices connected to Field Panels & Local Controllers
- Only 4 types of sensors/output “points”
  - Analog Input
  - Analog Output
  - Digital Input
  - Digital Output

## BAS 101 Page 1



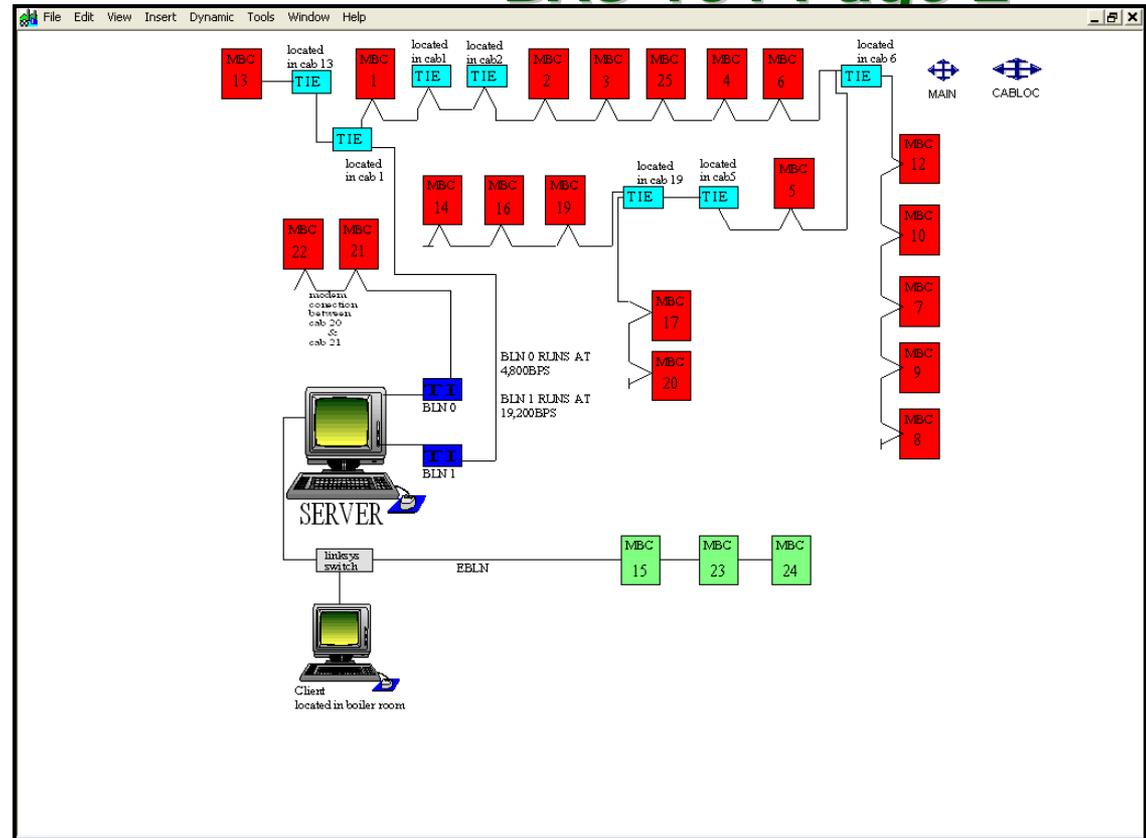


The usual function of a BAS is energy management and security. But if you can install any environmental sensor with a 4-20 mA or 0-10 Vdc output or dry contact closure, then you can connect that sensor to the BAS!

### PPPL's BAS:

1. 25 Field Panel or Modular Building Controller (MBC)
2. ~150 Local Controllers on Local Area Networks connected to the MBCs
3. ~4,000 Physical Sensors (AI/DI/AO/DO; POINTS) in the entire system
4. 32 Physical Environmental Sensors (POINTS) in our BAS

## BAS 101 Page 2





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Example of the "POINT" entry form for your sensor selection:

Field	Valid Entries	Data for this point	Comments
System Name & Name	Max. of 30 alphanumeric characters	DBFLMR	This is programmed relay #1 at the Model 2100 Eastech Badger Open Channel Flow meter
Point Type	DI, DO, AI, AO, etc Refer to summary of Logical Point Types	AI	Terminal strip A: NOTE there is 30-35 VDC at the 4-20 mA DC output at the meter
Descriptor	1 to 16 alphanumeric characters, spaces are counted.	DB OUTFLOW	The actual flow from the Detention Basin
Point Address	8-digit sequence. Refer to "Point Addressing," - TCCLSSPP	00 02 01 01	Need a AI termination point at Point Expansion Module
Totalization	Yes or No, Totalize in hours or in minutes.	Yes	We do want to know the total of the flow calculated by the BAS integration use the existing multiple points: day, pre day, month, pre month
Engineering Units	1 to 6 alphanumeric characters (e.g., Deg. F, PCNT, Deg. C, GPM, Gallon, kW, kWH, pH)	GPM	4-20 mA is 0-4,000 GPM
Sensor Type	Thermistor, Current, Voltage, Pneumatic, or Form C Dry Contact	Aux 4-20 mA DC Output Current	NOTE there is 30-35 VDC at the 4-20 mA DC output at the flow meter
Enhanced Alarm Message or ACAMS	BAS Enhanced Alarm:(4) lines of (50) characters each ACAMS: no limit	ACAMS alarm	Create ACAMS point if necessary and create message at this time. If ACAMS point exists review message.
Enhanced Alarm Message		ACAMS Message	



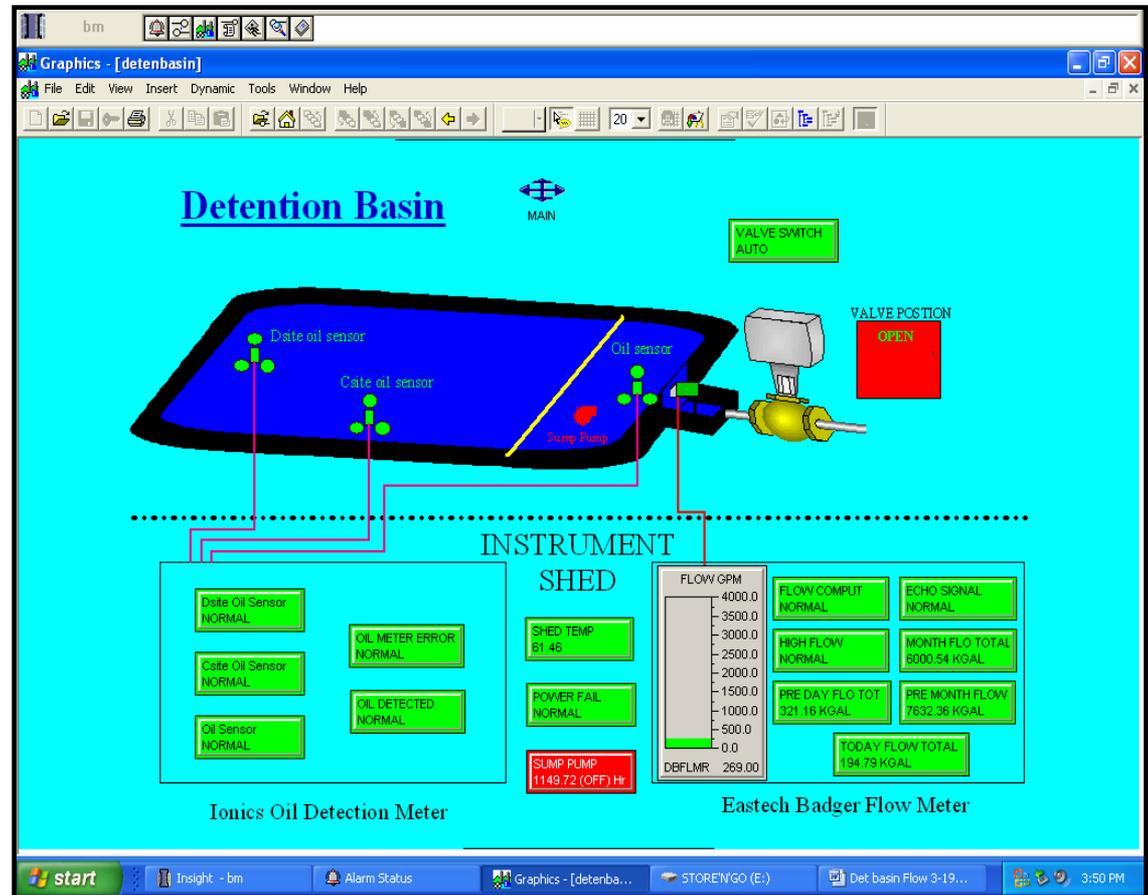
## BAS Environmental Monitoring at PPPL

- Spill Prevention Control & Countermeasure Plan
  - Retention (Detention) Basin Oil sensing and control
  - Hydraulic Elevator Equipment & Oil Storage Areas
  - Near future installation of spill oil sensing at Canal Pump House (located 2 miles from PPPL main site)
- Retention Basin Flow
  - Data is required for the Discharge Monitoring Report
  - Primary sensor is ultrasonic
  - Eastech Badger Flow Meter is connected to BAS with Point Expansion Modules



## Basin Spill Prevention Control & Countermeasure Plan and Flow

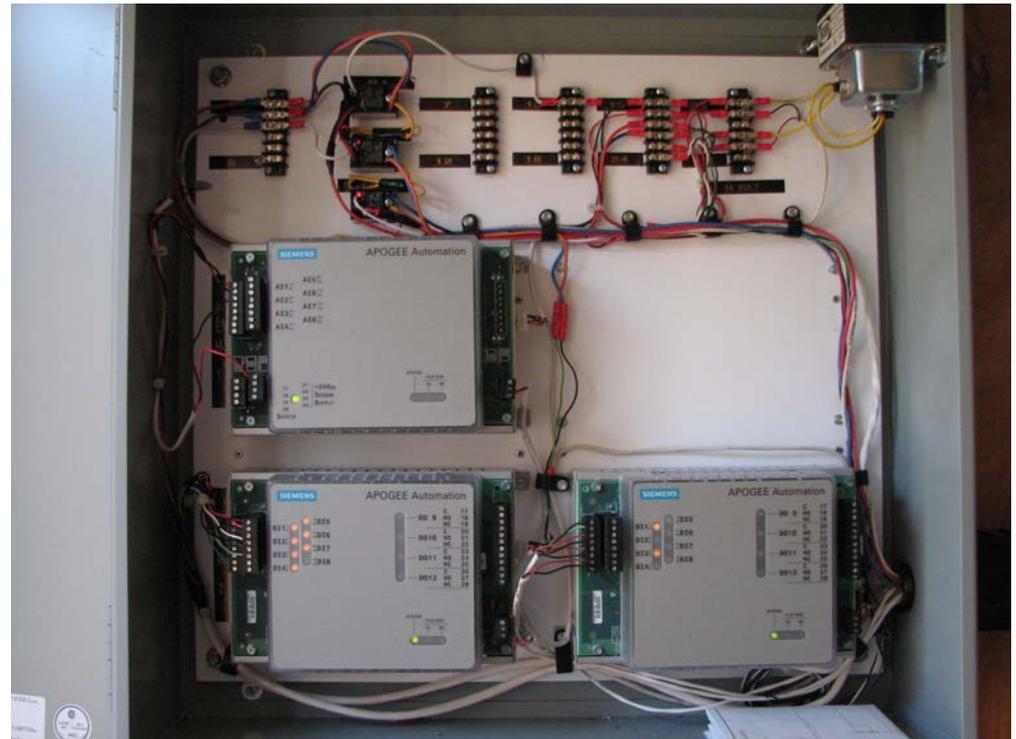
- Retention basin has 3 oil Ionics System sensors connected to the BAS
- First connected to Point Expansion Modules & then to a Modular Building Controller
- IF oil in ppm detected THEN outlet valve is shut AND alarm condition reported.
- High flow or flow meter problems alarmed & reported





## Basin Spill Prevention Control & Countermeasure Plan and Flow

- Oil Detection points & flow meter points are all connected to the BAS
- Through the Point Expansion Modules located at the basin.
- Then connected to a Field Panel & communicates to the front end server



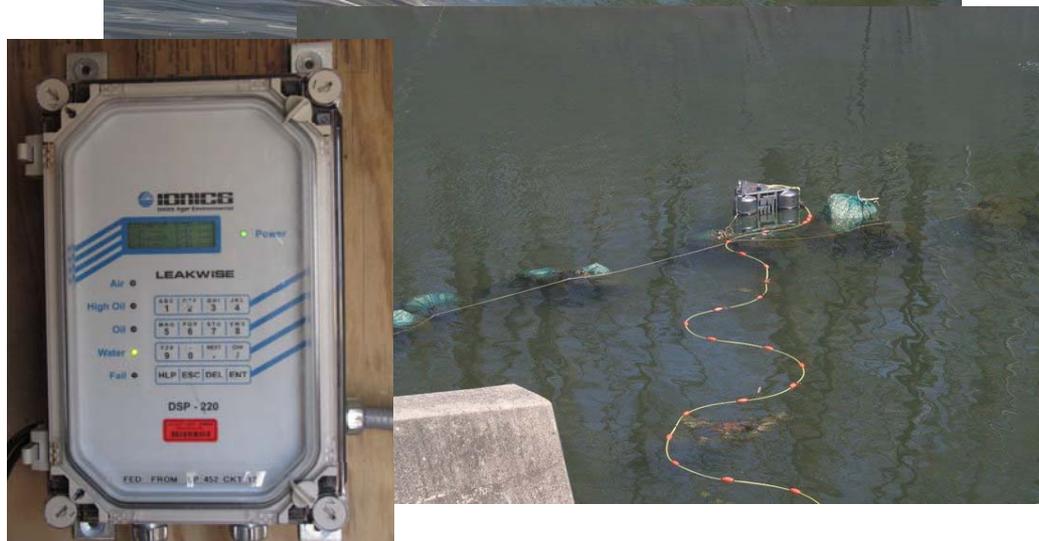
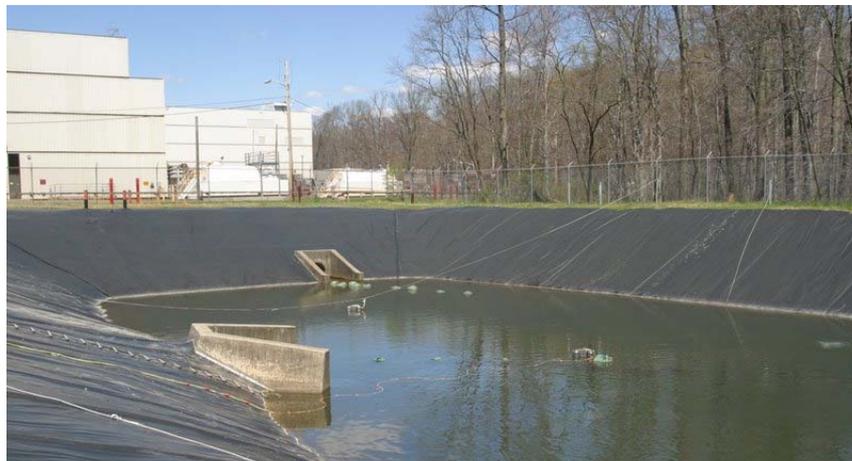


## Basin Spill Prevention Control & Countermeasure Plan

IONICS system

Components:

- Detectors, supported by floats or mounted at basin outflow
- Sensors connected to the local control panel & to then to Point Expansion Modules





## Basin Spill Prevention Control & Countermeasure Plan

### Example of Oil detection Alarms:

**For the PPMC analog input at LOW alarm level [4 ppmc or 5 ppmc]**

LOW OIL CONCENTRATION ALARM LEVEL

IN WATER AT DETENTION BASIN

INVESTIGATE BASIN FOR OIL SHEEN

CONTACTS USING NOTIFICATION GUIDE # ER/WM-004

**For the PPMC analog input at HIGH alarm level [6 ppmc or 8 ppmc]**

HIGH OIL CONCENTRATION ALARM LEVEL

IN WATER AT DETENTION BASIN

INVESTIGATE BASIN FOR OIL SHEEN

CONTACTS USING NOTIFICATION GUIDE # ER/WM-004

**For the Hand Off Auto switch for the gate valve in OFF or HAND**

DETENTION BASIN GATE VALVE NOT IN AUTO POSITION

INVESTIGATE BASIN FOR HIGH WATER LEVEL

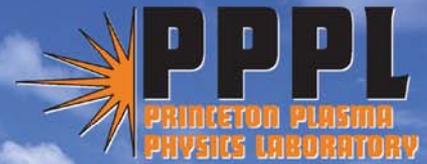
CHECK GATE VALVE HOA SWITCH POSITION

CONTACTS USING NOTIFICATION GUIDE # ER/WM-004



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On March 7, 2008  
the system was  
tested when oil  
reached the  
Detention Basin and  
caused a  
oil slick.

We think oil sheen  
was from the  
testing of a  
sprinkler system  
discharge to a  
trench drain with  
old oil film in the  
trench drain.





## Basin DMR Flow Meter System

Basin Flow meter components:

- Flow meter local readout
- Ultrasonic level sensor & weir dam
- Flow Data is stored in the BAS TREND & at the flow meter memory register





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## Basin DMR Flow Meter System Raw Data

Date / Time	Level 1 (INCHES)	Flow 1 (GPM)	Total 1 (GAL x 10)
7/3/2007	0.234402	25.33211	396870
7/3/2007 1:00	0.269026	31.14735	397092
7/3/2007 2:00	0.344414	45.11814	397352
7/3/2007 3:00	0.259272	29.46884	397583
7/3/2007 4:00	0.247784	27.53209	397840
7/3/2007 5:00	0.26935	31.20368	398094
7/3/2007 6:00	0.235897	25.57492	398299
7/3/2007 7:00	0.275257	32.23577	398508
7/3/2007 8:00	0.50852	80.94545	398869
7/3/2007 9:00	0.411352	58.8913	399280
7/3/2007 10:00	0.370321	50.3035	399640
7/3/2007 11:00	0.359671	48.14907	400021
7/3/2007 12:00	0.232008	24.94508	400258
7/3/2007 13:00	0.193766	19.03906	400399
7/3/2007 14:00	0.146889	12.56647	400535
7/3/2007 15:00	0.208305	21.22175	400641
7/3/2007 16:00	0.216249	22.44724	400751
7/3/2007 17:00	0.114248	8.619953	400842
7/3/2007 18:00	0.164074	14.83508	400911
7/3/2007 19:00	8.33E-02	5.362865	400966
7/3/2007 20:00	0.144316	12.23773	401014
7/3/2007 21:00	0.191486	18.70412	401105
7/3/2007 22:00	0.166096	15.11012	401240
7/3/2007 23:00	0.191441	18.69741	401366
7/4/2007	0.219492	22.954	401523



## Basin DMR Flow Meter System

### **What do you need the flow data for???**

We need the data from the flow meter for our Discharge Monitoring Report; therefore flow meter operation must be monitored & alarmed.

### **Examples of Flow Meter Alarms:**

#### **For loss of level sensor on the Flow Meter**

FAILURE OF FLOW METER SENSOR AT DETENTION BASIN  
INVESTIGATE BASIN FOR HIGH WATER LEVEL  
CONTACTS USING NOTIFICTION GUIDE # ER/WM-004

#### **For loss of computer on the Flow Meter**

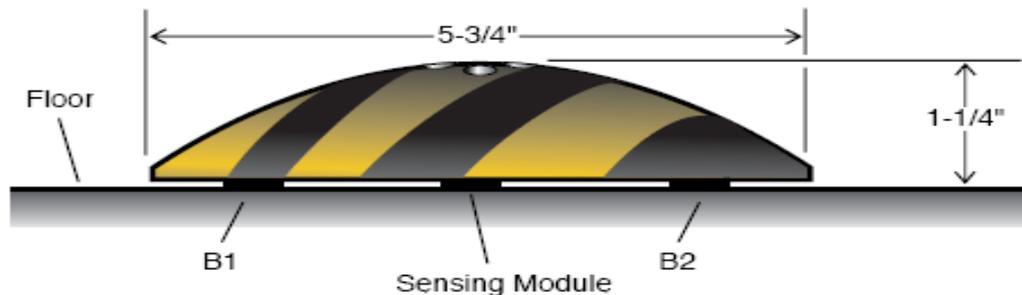
FAILURE OF FLOW METER COMPUTER AT DETENTION BASIN  
CONTACT ER/WM AT X-3380 DURING WORKING HOURS



## Spill Prevention Control & Countermeasure Plan



*When liquid film (oil etc.) comes in contact with the "sensing module", it is absorbed. An optical detector then activates the device!*

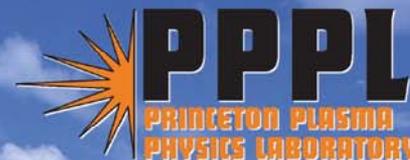


Both PPPL & SNL are using Oil Alert sensors



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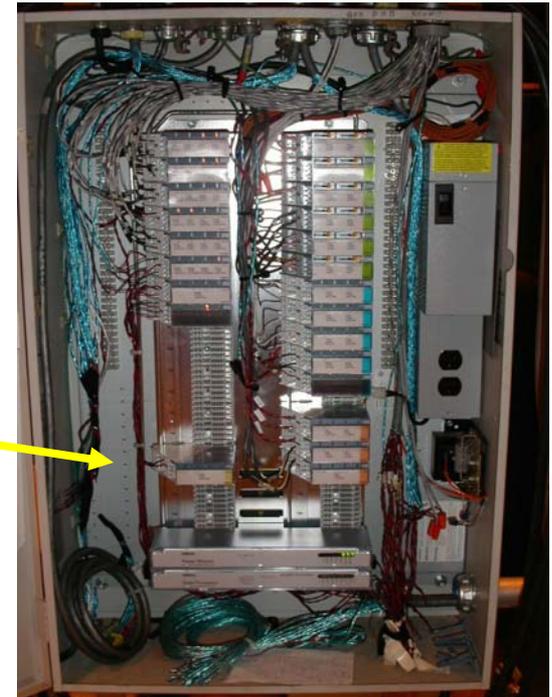
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SPCC Points Added to MBC #2				
Point Type	Logical Point Name	Point Description	Point	INPUT OR OUTPUT DEVICE
DI	MGOS1	Liquid Sensor for C-site MG Oil Tank #1	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	MGOS2	Liquid Sensor for C-Site MG Oil Tank #2	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	MGOS3	Liquid Sensor for C-Site MG Oil Tank #3	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	MGOS4	Liquid Sensor for C-Site MG Oil Tank #4	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	CSOS1	Liquid Sensor for CS Bldg Elevator Pump Area	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	CSOS2	Liquid Sensor for CS Bldg Elevator Pit Area	N.C. Cont. Closure	Dorlen OA-5 sensor w/ voltage module
DI	SPC1HL	Sump #1 High Level	Dry Cont. Closure	WeilARM High Water Alarm
DI	SPC2HL	Sump #2 High Level	Dry Cont. Closure	WeilARM High Water Alarm
DI	SPC3HL	Sump #3 High Level	Dry Cont. Closure	WeilARM High Water Alarm
DI	SPC4HL	Sump #4 High Level	Dry Cont. Closure	WeilARM High Water Alarm
DI	CMGOSR	Push Button to reset horn & amber light point; CMGOSA	N.O. Cont. Closure	Push Button
DO	CMGOSA	Point will energize Horn & Strobe in C-Site MG Area	N. O. Cont. Closure	Horn & Amber Light
DO	SMPCTL	Point will open contacts in Sump Pump Control Circuits	Dry Cont. Closure	Relays
DI	CMGOOR	Key Actuated Switch to Manually Override point SMPCTL	Dry Cont. Closure	Key Switch
NOTE: The Dorlen OA-5 sensors w/ voltage module & the WeilARM, compression type High Water Alarms will be supplied by PPPL.				



## Spill Prevention Control & Countermeasure Plan



The Oil Alert sensors are connected directly to the Field Panels at a Digital Input (DI) point:

- Wired as "FAIL SAFE"
- Alarms go security & maintenance



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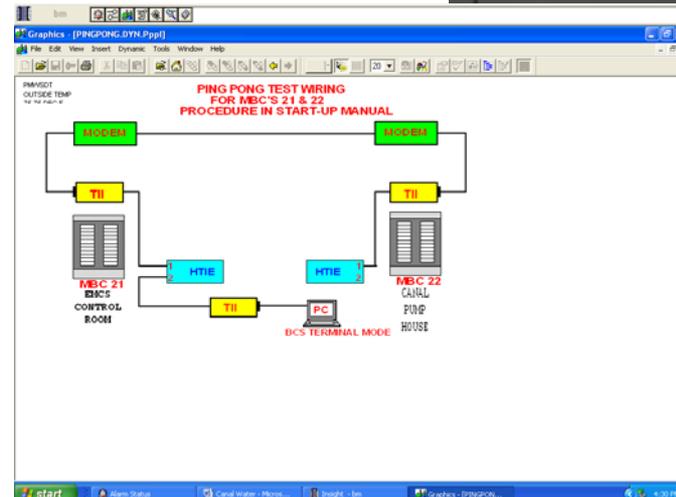
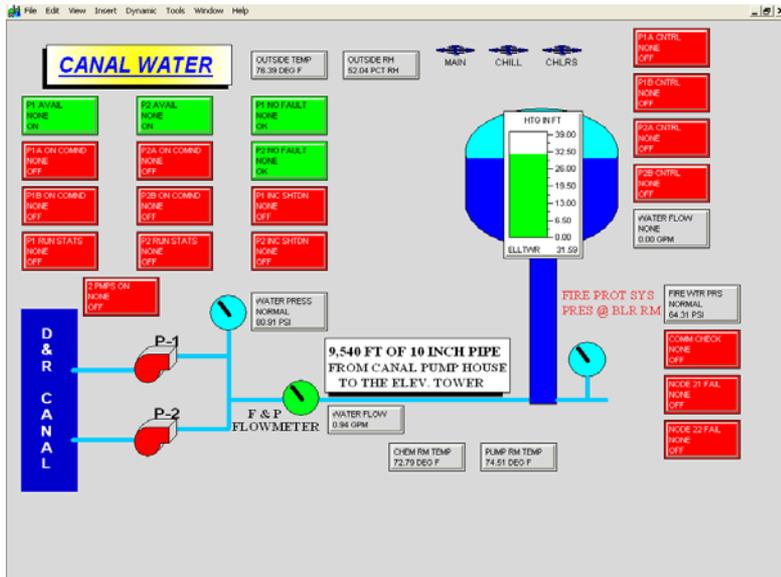
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## Spill Prevention Control & Countermeasure Plan

PPPL's next "Environmental Expansion" will be Oil Alerts installed at the D&R canal pump house.

This building is ~2.5 miles away and a BAS can be still used for control, monitoring & alarming. A dedicated modem/telephone line is for communication.





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## Building Automation System (BAS) Utilized for Environmental Monitoring

### References:

- Oil Alert Detectors:  
<http://www.wateralert.com/>
- Ultrasonic Open Channel Flow Meter:  
<http://www.eastechflow.com/>
- Oil on Water Detection System:  
[http://www.geinstruments.com/ionics/index.cfm?category\\_code=OilonWater](http://www.geinstruments.com/ionics/index.cfm?category_code=OilonWater)

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