Fully Automated Fish Tank System

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It would be nice never (vary rarely) having to do any maintenance on an aquarium. With a small microprocessor, electric valves, pumps, sensors, etc., it should be possible to do the following:

1. Automatic water changes every day.

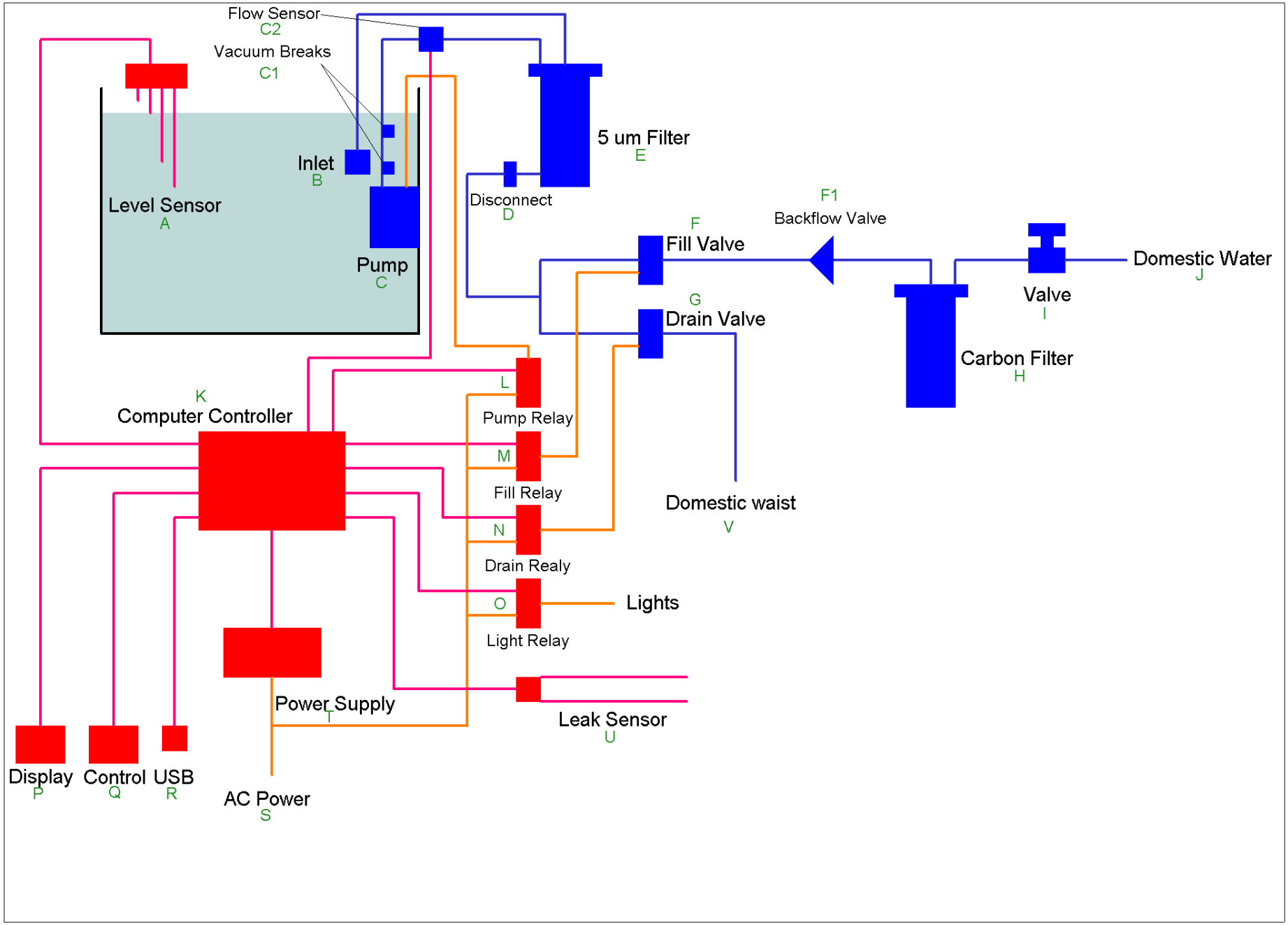
2. Automatic back flushing of debris from filter elements.

3. Sold waists could be automatically collected and discarded with a "glass bottom" style aquarium.

4. The input water filter could last up to 10,000 gallons (rated at >20,000 gallons). At a 10 gallon/day change rate, it would last about three years. The spun filter will last longer since solid waists are purged from it and possibly the entire tank. It may last months with solid debris removal and daily 25% water changes...

5. The computer system could easily control lights too with just another relay.

6. The computer system would monitor and control fault conditions and sound a level specific warning. It would also monitor the system and detect failing components.


Flow Sensor
C2
Vacuum Breaks
C1
5 um Filter
E
Inlet
B
Level Sensor
A
Disconnect
D
Pump
C
F1
Backflow Valve
F
Fill Valve
Domestic Water
J
Valve
I
G
Drain Valve
Carbon Filter
H
K
Computer Controller
L
Pump Relay
M
Fill Relay
Domestic waist
V
N
Drain Realy
O
Lights
Light Relay
Power Supply
T
Leak Sensor
U
Display
P
Control
Q
USB
R
AC Power
S

A. Four electrode water level sensor. Made from stainless steel or titanium thin rod. Buffered with Darlington transistors to 5V digital levels.

B. Inlet filter with activated carbon. Easy to twist off and replace carbon.

C. Small ~5W submersible fountain pump.

C1. Redundant vacuum breaks to prevent drainback.

C2. Flow Sensor (0.5 GPM).

D. Disconnect so filter body can be removed. This port is drilled and threaded into the base of the filter body to allow back flushing of collected debris on the dirty side of the filter.

E. Common 10 inch filter body (preferably clear).

F - G. Fill and drain solenoid valves as used on Maytag and many other clothes washers. The drain valve should have the screen removed.

F1. Anti-Backflow valve to prevent water supply contamination.

H. 0.5um carbon 10 inch drinking water filter with 0.6 GPM flow.

I. Main water shutoff valve.

J. Domestic water supply line.

K. Computer controller probably using the Basic Stamp BS2p-40. Might need real time clock IC.

L - O. Low level 5V to 120VAC control relays.

P. Led display and sonolert panel lights. Could also have LCD display.

Q. Control switches.

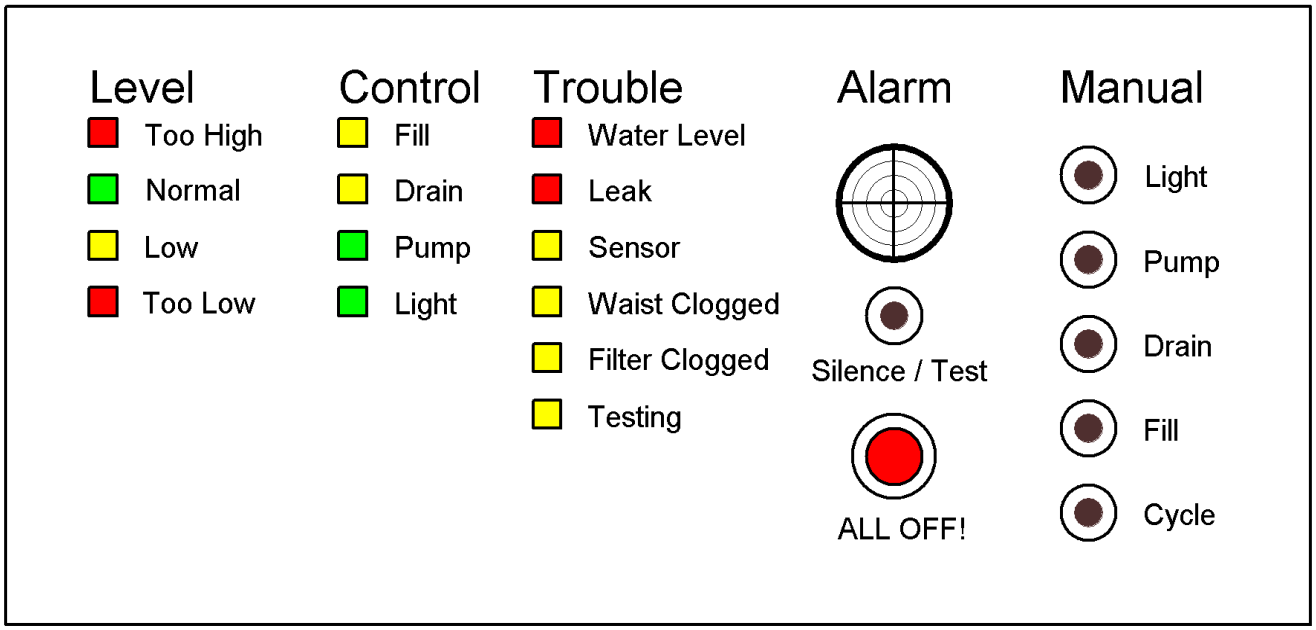
R. Computer programming or communications port.

S. AC line power. Fused and note water hazard area...

T. Battery backup 120VAC to ~7VDC power supply to run electronics.

U. String water sensor loop to detect water leak.

V. Domestic drain.



Control Panel with LED indicator lights, switches, and alarm system.

Present undersink style carbon drinking water filter.

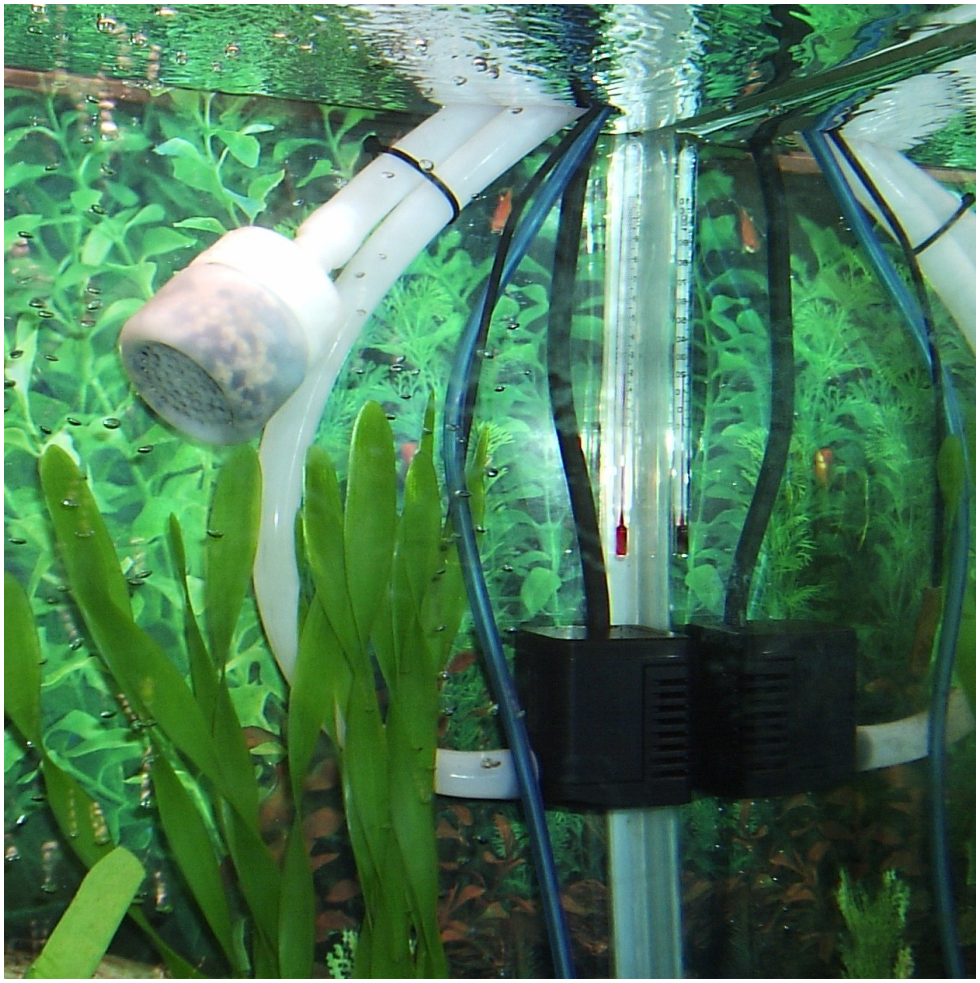
Present 5um spun aquarium filter

Clear style "whole house" 10 inch water filter body.

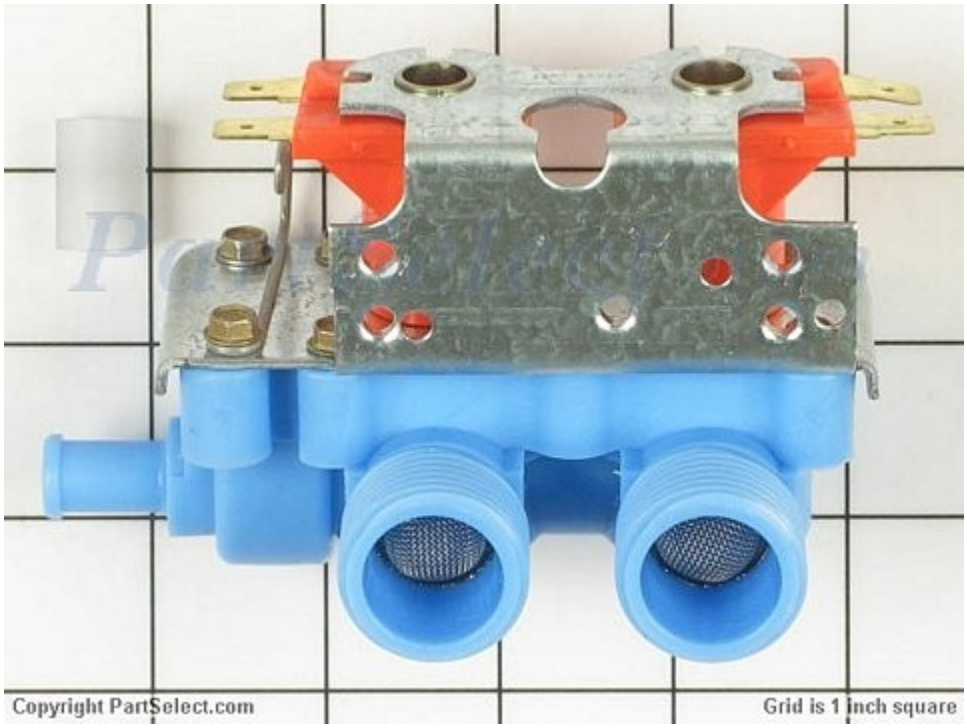
Water filter cartridge specifications.

http://www.waterfilters.net/PDF/Sediment_Filters/P_Filter_Series.pdf

http://www.waterfilters.net/PDF/Carbon_Filters/CBR2_Filter_Series.pdf



Present pump and inlet filter system.



Maytag style clothes washer dual solenoid electric water valve

Relays:
http://www.parallax.com/detail.asp?product_id=400-00010

Flow Sensors:

http://www.digikey.com/scripts/DkSearch/dksus.dll?Detail?Ref=472992&Row=126475&Site=US

http://www.digikey.com/scripts/DkSearch/dksus.dll?Criteria?Ref=391&Site=US&Cat=34538252

Item / Function	Failure Mode	Cause(s) / Mechanism(s) of Failure	Effect(s) of Failure	End Result(s) of Failure	Sev	Occur	Detect	R.P.N.	CODE	Current Design Controls	CODE	Recommended Actions	CODE
A. Level Sensor													
	Wrong Location (in tank)	Out Of Position	Sensor Level Too High	Sensor Level Too High	3	3	1	9		On High Level - Close Fill, Open Drain, fill slower than drain			
	Wrong Location (out tank)	Out Of Position	Sensor Level Too Low	Sensor Level Too Low	3	3	1	9		On Low Level - Close Valves, turn off pump			
	Erroneous Reading	Any Reason	Sensor Makes No Sense	Sensor Makes No Sense	3	2	1	6		On Bad Sensor - Close Valves, turn off pump			
	Intermittent Reading	Bubbles	Sensor Gives Random Readings	Wrong Action (oscillation)	5	2	2	20		STOP Always check sensor multiple times			
B. Inlet													
	Clogged	Any Reason	No Filter Flow	No Filter Flow	2	3	3	18		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
	Not In Tank	Out Of Position	Flood	Flood	5	2	4	40		Visual Check - Leak Sensor - Low Level Action		Tie lines together	
C. Pump													
	Not Pumping	Any Reason	No Filter Flow	No Filter Flow	3	2	1	6		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
			Drain May Not Work		3	2	1	6		Visual Check - Not a big problem which will be found in time			
	Tube Disconnected	Out Of Position	No Filter Flow	No Filter Flow	3	2	2	12		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
			Drain May Not Work		3	2	1	6		Visual Check - Not a big problem which will be found in time			
			Flood	Flood	5	2	4	40		On Low Level - Close Valves, turn off pump		Tie lines together	
	Not In Tank	Out Of Position	No Filter Flow	No Filter Flow	3	2	2	12		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
			Drain May Not Work		3	2	1	6		Visual Check - Not a big problem which will be found in time			
			Flood	Flood	5	1	1	5		Visual Check - Leak Sensor - Low Level Action			
C1. Vacuum Break													
	Clogged	Any Reason	Tank Drain	Dead Fish	5	1	3	15		Redundant Vacuum Breaks - Low Level Action			
	Leaks (too big)	Holes too big	Poor Filter Flow		2	1	3	6		Visual Check			
C2. Flow Sensor													
	Clogged	Any Reason	No Filter Flow	No Filter Flow	2	3	3	18		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
	Leaks	Any Reason	Flood	Flood	4	2	3	24		Redundant Vacuum Breaks - Low Level Action		Position above water level	
	Wrong Reading (flow when noflow)	Any Reason	Flow when no flow	Might trigger wrong error		2	3			Easily Testable			
	Wrong Reading (noflow when flow)	Any Reason	No flow when flow	Might trigger wrong error		2	3			Easily Testable			
D. Disconnect													
	Comes Loose	Any Reason	Flood	Flood	5	1	3	15		Redundant Vacuum Breaks - Low Level Action		Position above water level	
	Clogged	Any Reason	No Drain		3	1	2	6		Drain timeout Error			
			No Fill		3	1	2	6		Fill timeout Error			
	Leaks	Any Reason	Flood	Flood	4	2	3	24		Redundant Vacuum Breaks - Low Level Action		Position above water level	
E. Sum Filter													
	Clogged	Any Reason	No Filter Flow	No Filter Flow	3	4	2	24		Visual Check - Not a big problem which will be found in time		Flow Sensor/Indicator	
	Leaks	Any Reason	Flood	Flood	4	2	2	16		Redundant Vacuum Breaks - Low Level Action		Position above water level	
F. Fill Valve													
	Stuck Open	Any Reason	Flood	Flood	5	2	4	40		On High Level - Close Fill, Open Drain, fill slower than drain			
	Stuck Closed (clogged)	Any Reason	No Fill	No Fill	3	2	2	12		Fill timeout Error			
	Leaks	Any Reason	Flood	Flood	4	2	2	16		Redundant Vacuum Breaks - Low Level Action		Position above water level	
F1. Backflow Valve													
	Stuck Open	Any Reason	Water Contamination	Water Contamination	4	1	4	16		Unlikely			
	Stuck Closed (clogged)	Any Reason	No Fill	No Fill	3	1	2	6		Fill timeout Error			
	Leaks	Any Reason	Flood	Flood	4	1	2	8		Leak Sensor		Position above water level	
G. Drain valve													
	Stuck Open	Any Reason	Dry Tank	Dead Fish	3	2	3	18		Redundant Vacuum Breaks - Low Level Action			
	Stuck Closed (clogged)	Any Reason	No Drain	No Drain	3	2	3	18		Drain timeout Error			
	Leaks	Any Reason	Flood	Flood	4	2	2	16		Redundant Vacuum Breaks - Low Level Action		Position above water level	
H. Carbon Filter													
	Clogged	Any Reason	No Fill	No Fill	3	1	1	3		Fill timeout Error			
	Leaks	Any Reason	Flood	Flood	4	2	2	16		Leak Sensor		Slow leak - Leak Sensor	
	Old (Carbon Dead)	Left in too long	Water Contamination	Water Contamination	4	2	1	8		Change every year			
I. Input Valve													
	Stuck Open	Any Reason	Can't Shut Off Water (there)	Can't Shut Off Water (there)	1	1	1	1		Unlikely and easy to spot with no damage			
	Stuck Closed	Any Reason	No Fill	No Fill	3	1	1	3		Unlikely and easy to spot with no damage			
	Leaks	Any Reason	Flood	Flood	4	2	2	16		Leak Sensor		Slow leak - Leak Sensor	
J. Domestic Water													
	Loss Of Pressure	Any Reason	No Fill	No Fill	3	3	2	18		Fill timeout Error			
			Back Flow	Back Flow	4	2	4	32		Anti-backflow Valve			
K. Computer Controller													
	Shorted Control Line	Any Reason	Driver Damage	Driver Damage	4	0	3	0		Proper design			
	Open Control Line	Any Reason	No Function	No Function	3	2	2	12		Unlikely and easy to spot with no damage			
	Loss Of DC Power	Any Reason	System Off	System Off	3	2	3	18		Fails in place			
L. Pump Relay													
	Stuck Short	Any Reason	Pump Always On	Pump Always On	2	1	2	4		Unlikely and easy to spot with no damage			
	Stuck Open	Any Reason	Pump Always Off	Pump Always Off	3	1	2	6		Unlikely and easy to spot with no damage		Flow Sensor/Indicator	
M. Fill Relay													
	Stuck Short	Any Reason	Fill Relay Always On	System Overflow	5	1	4	20		On High Level - Close Fill, Open Drain, fill slower than drain			
	Stuck Open	Any Reason	Fill Relay Always Off	System Low Level	3	1	2	6		Fill timeout Error			
N. Drain Relay													
	Stuck Short	Any Reason	Drain Relay Always On	Dead Fish	3	1	3	9		Redundant Vacuum Breaks - Low Level Action			
	Stuck Open	Any Reason	Drain Relay Always Off	System won't drain	3	1	3	9		Drain timeout Error			
O. Light Relay													
	Stuck Short	Any Reason	Lights Always On	Lights Always On	1	1	1	1		Unlikely and easy to spot with no damage			
	Stuck Open	Any Reason	Lights Always Off	Lights Always Off	1	1	1	1		Unlikely and easy to spot with no damage			