Press Release:

Astrotecture™ Wins 2012 NASA NIAC Grant:

Water Walls Architecture

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1 August 2012 – NASA announced the award of a 2012 NASA Innovative and Advanced Concepts Fellowship to Michael Flynn, NASA Ames Research Center as Principal Investigator for the proposal entitled:

Water Walls: Highly Reliable and Massively Redundant Life Support Architecture

http://www.nasa.gov/offices/oct/early_stage_innovation/niac/niac_2012_phaseIandII_awards.html

The Water Walls team members are:
Marc M. Cohen Architect P. C./Astrotecture™, Palo Alto, CA. CoI for Space Architecture and Project Manager
Michael Flynn, Bioengineering Branch, NASA-Ames Research Center, Moffett Field, CA. PI
Renée Matossian, San Mateo, CA. Space Architect
Elysse Grossi, Grad Student, NASA Ames-Education Associates Program
Lara Vimercati, Grad Student, NASA Ames-Education Associates Program

The Water Walls Proposal Summary states:

The lungs of our planet – the forests, grasslands, marshes, and oceans – revitalize our atmosphere, clean our water, process our wastes, and grow our food by mechanically PASSIVE methods. Nature uses no compressors, evaporators, lithium hydroxide canisters, oxygen candles, or urine processors. For very long-term operation as in an interplanetary spacecraft, space station, or lunar/planetary base, these active electro-mechanical systems tend to be failure prone because the continuous duty cycles make maintenance difficult and redundant systems to allow downtime bulky, expensive, and heavy. In comparison, Nature's passive systems operate using biological and chemical processes that do not depend upon machines and provide sufficient, redundant cells that the failure of one or a few is not a problem.

WATER WALLS (WW) takes an analogous approach to providing a life support system that is biologically and chemically passive, using mechanical systems only for plumbing to pump fluids such as gray water from the source to the point of processing. The core processing technology of Water Walls is FORWARD OSMOSIS (FO). Each cell of the WW system consists of a polyethylene bag or tank with one or more FO membranes to provide the chemical processing of waste. WW provides four principal functions of processing cells in four different types plus the common function of radiation shielding:

1. Gray water processing for urine and wash water,
2. Black water processing for solid waste,

3. Air processing for CO2 removal and O2 revitalization,
4. Food growth using green algae, and
5. Provide radiation protection to the crew habitat (all cells).

Although chemically and biologically different, these cells are physically similar in size and shape, so they can be physically integrated into the WW system. With this cellular and modular approach, the WW system is designed to be highly reliable by being massively redundant. As part of the spacecraft design, the replaceable cells and modules are installed in the structural matrix. Before departure, they are primed with water and starter ion solutions. As one cell for each function is used up, it is turned off; the next one turns on by opening valves to admit the appropriate fluids. The spacecraft carries backup FO bags and/or membranes. The crew can replace exhausted cells with new units. In this concept, WW can replace much of the conventional mechanically-driven life support that is so failure-prone with a reliable system that also affords “non-parasitic” radiation shielding and can grow basic protein and carbohydrates to sustain the crew over multi-year missions.

Water Walls:

Highly Reliable, Massively Redundant Life Support Architecture

Michael Flynn, NASA-Ames, PI
Marc M. Cohen, Architect, CoI

THE PROBLEM:

- **Low Relibility Mechanical Life Support Systems**
- **High Mass and Cost of Resupplying LS Consumables**

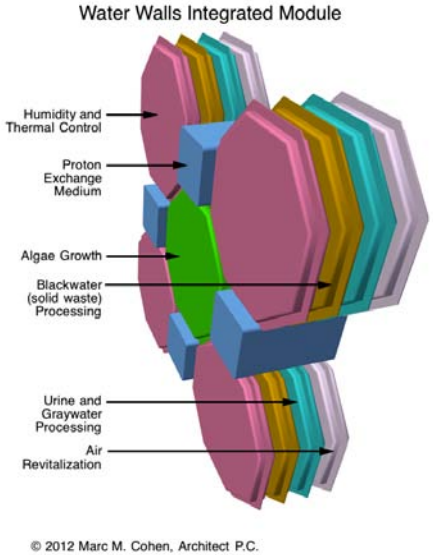
The lessons learned from the development of the ISS life support system are that mechanically complex system are unreliable, difficult to maintain, expensive, and require high-mass and cost. resupply of consumables.

Algae Growth Experiment FO Bag

THE SOLUTION: Water Walls --

- **High Reliability, Mechanically Passive Life Support Architecture, using Forward Osmosis (FO) Electrochemical Processes**
- **Low Resupply Mass and Cost**

Water Walls incorporates life support, thermal, and radiation protection functions into the walls of the spacecraft. WW saves mass by combining radiation protection, thermal control, and life support functions within the mass allocation of a sole-purpose radiation shield.



- The WW module combines the key functions of air, water, and waste processing, water recovery, and thermal control in an ensemble that provides ~40cm of radiation shielding.
- The effluent from one FO bag is the feedstock to another FO bag or PEM cell.

X-Drink Bag water purification with Ames-developed FO Membrane

STS-135 Flight expt. Urine/H20 FO Bag