Force Solaire EcoPower™

Revolutionary New Thermal Absorption Power.

Frederick H. Schuchardt
President and CEO
Force Solaire Inc

Eric Aylaian, PhD
Chief Technology Officer
Force Solaire Inc

Key Personnel

Frederick H. Schuchardt – President and CEO

- Mr. Schuchardt is a pioneer, innovator and proven entrepreneur with over 40 years' experience in the software, communications and renewable power industries
- He has participated in private and public offerings, and is experienced in leading high technology development teams and product-to-market successes
- Schuchardt co-invented the "Mass Magnifier", a breakthrough technology that made flywheels usable and practical for long-term energy storage
- In 1983 he pioneered Office Suite Software called "InteSoft", a modularly integrated family of PC productivity products with a consistent user interface
- Education: Georgetown University – International Affairs; Long Island University BA in Mathematics and Computer Science; MBA Program at Boston University, Brussels, Belgium Campus.

Key Personnel

Dr. Eric Aylaian – Chief Technology Officer

- Dr. Eric Aylaian has over 30 years' experience in hi-technology, including MTBF/Weibull analysis, failure analyses, SEM/TEM, EDX/EDS, TOF-SIMS, Material analysis, advanced chemical engineering, advanced metallurgical analysis, PCB design, PB test, Manufacturing (on-shore and off-shore), management, mentoring, consulting and other specialties.
- As Director of Engineering at Integrated Photovoltaics, Dr. Aylaian supported the development of a "synthetic" solar cell, utilizing amorphous doped/undoped silica deposited onto various substrates via PECVD (Plasma Enhanced Chemical Vapor Deposition) followed by laser or heat ZMR (Zone Melting Recrystallization) and follow-up studies utilizing clinical methodologies to enhance lifetime carrier mobility and cell efficiency.
- As Principal Engineer at KLA-Telco he reviewed and redesigned multiple products within various inspection lines to enhance micro, macro and system performance, both analog and digital.
- As Director of Reliability and Testing at Extreme Networks, Dr. Aylaian was responsible for all F/A activities, including components, all Reliability Studies, all Test Development, all qualification analyses for components. Performed COS analyses for new PCBAs, designed new products, and developed new processes, by managing and mentoring at least 32 engineers, scientists and technicians.
- Dr. Aylaian holds a PhD in Solid State Physics from Century University and a MSEE in Device Physics and a MSME in Mechanical Engineering from Trinity College and University, and a BSME of Mechanical and Electrical Engineering from the University of California, San Diego.

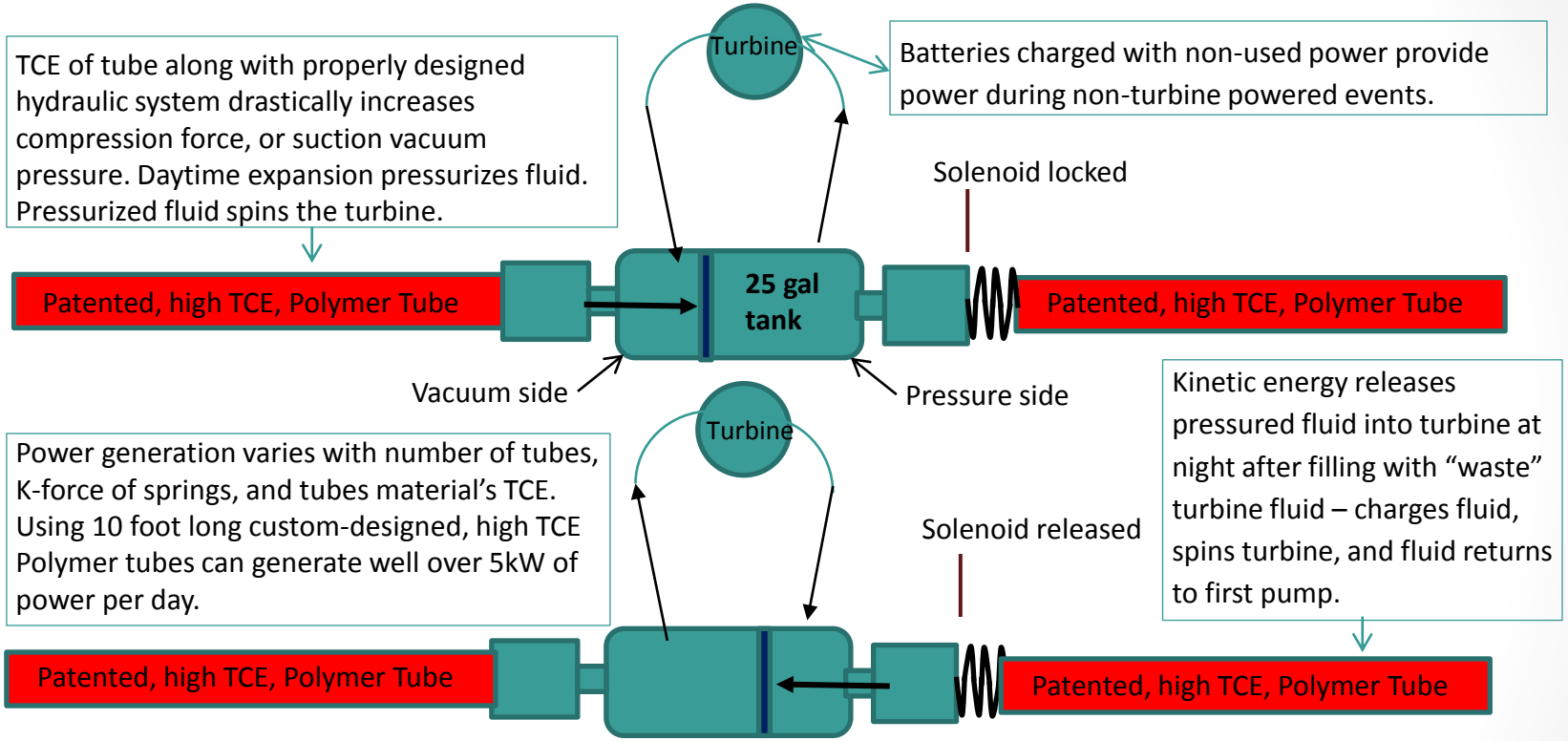
Solar Power – Overview

- Today's solar power systems involve either focused mirror arrays, focusing intense solar energy only on a single spot to generate superheated steam, or solar panels consisting of photovoltaic wafers (PV panels) laid-out in a grid pattern receiving solar energy. In either case, the performance of these systems degrades consistently and measurably as dust, dirt, and other contaminants collect on the mirrors or the top surface of the panels.
- Because the best performing solar systems are located in desert climates, there is little to no water to clean these surfaces, and even where there is water, cleaning can change the mirror alignment, damage the panels/wiring, or have other deleterious effects.
- The design presented here utilizes changes in temperature as is typical during a day when solar heating occurs, but uses no mirrors or PVs to utilize photon energy from the sun. Its simplistic design is also dust-exempt, meaning there is no requirement to maintain a dust-free deployment, and no alignment or other requirements exist either.
- Furthermore, the system cost is significantly lower than that of typical PV or concentrating mirror assemblies, and the deployed system footprint is smaller, in most cases, then either PV or concentrating mirror systems.

TCE Thermal Power – Abstract

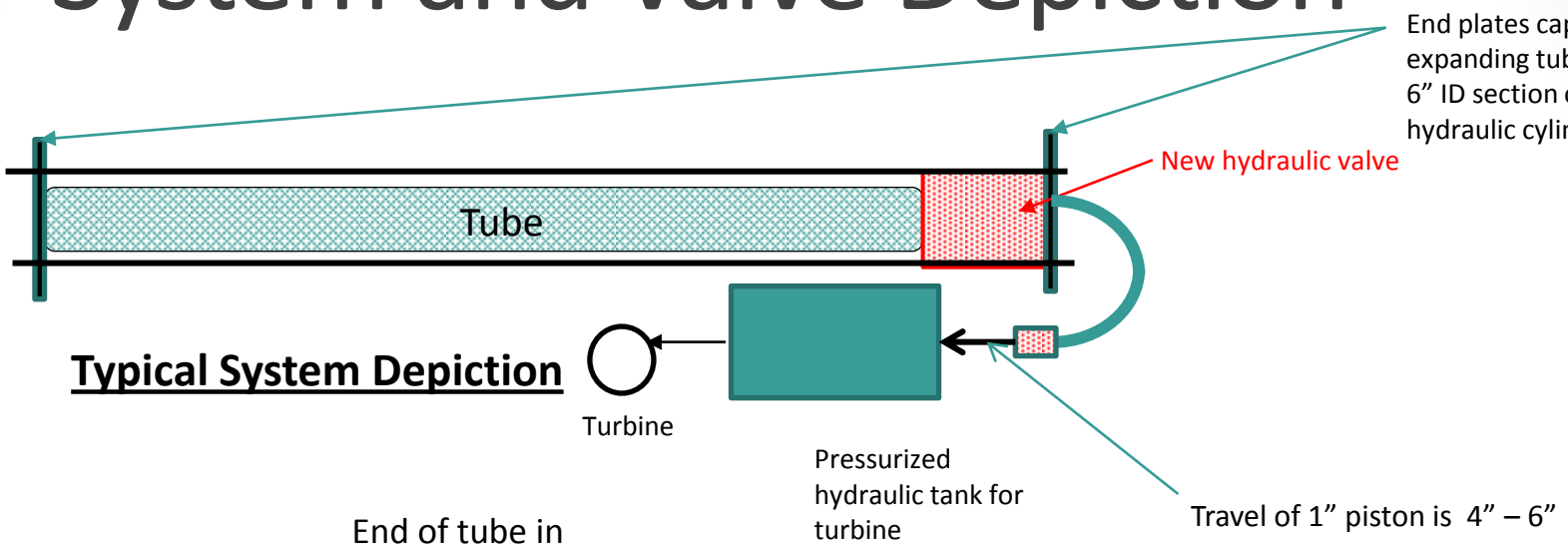
- Force Solaire's breakthrough Thermal Absorption Technology is designed to utilize the sun to generate massive amounts of power without solar panels.
- The system utilizes changes in material properties due to thermal changes, or thermal coefficient of expansion (TCE), which occurs either as the days ambient temperature rises, or cools. A typical system consists of a material with a high TCE, but also caries excellent compressive force durability.
- The design is such that it properly orients and optimizes TCE growth in a singular direction, such that as the material is heated during a typical day (25 degrees Fahrenheit or more), the TCE expansion is utilized to drive a properly designed fulcrum to compress either water-based or hydraulic fluid, so that it may be used for myriad applications such as water filtering for water desalinization, or to generate high-pressure hydraulic fluid that can be used to drive a turbine connected to a power generation system.
- Just as the system expands during the day, it also retracts at night, and kinetic energy storage is used for the same applications.
- The system offers both daytime and nighttime power in a way that is immune to dust, dirt and other debris.

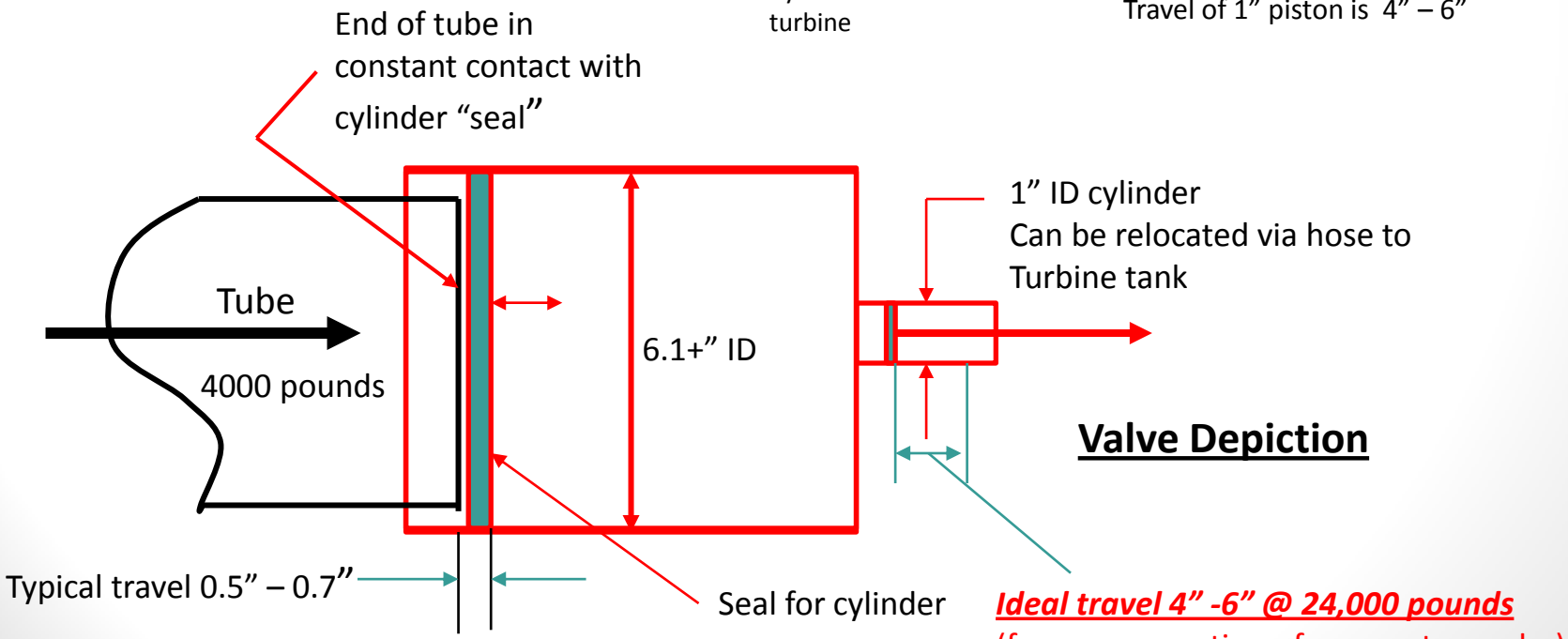
Underlying Magic / Technology – Revolutionary Thermal Absorption Power



Each tube pressurizes its own 6" to 1" piston, which compresses the fluid. After one side of the system's cycle is complete, the other side, which has been compressing a spring, and held by a solenoid, releases, pressurizing the system in reverse. The tank, 25 gallon capacity, is sending high-pressure fluid to the turbine, then back to the tank, wherein it is used again to drive the turbine. The 25 gallon tank thus "acts" as a 50 gallon tank for the turbine, and two to four high pressure cycles are available. The tank is pressurized to between 100 and 150 psi during each side's drive, which would require 4 to 6 inches of travel at 10,000 pounds; the force available to the driving rod is up to 25,600 pounds.

System and Valve Depiction





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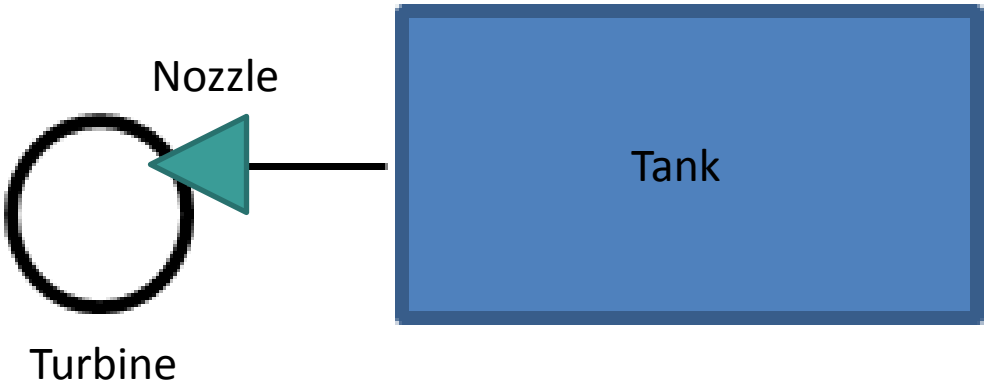
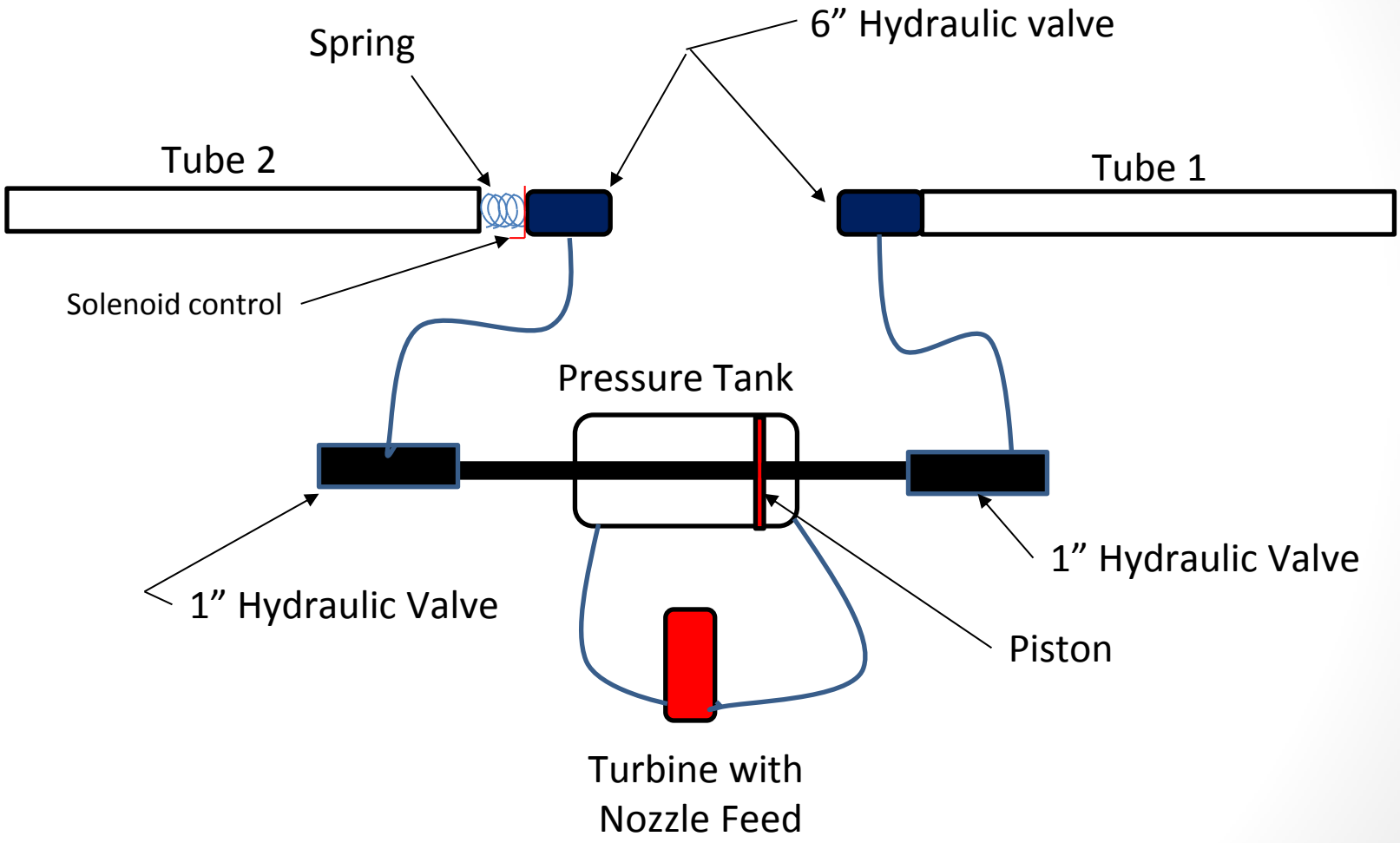
Turbine Design



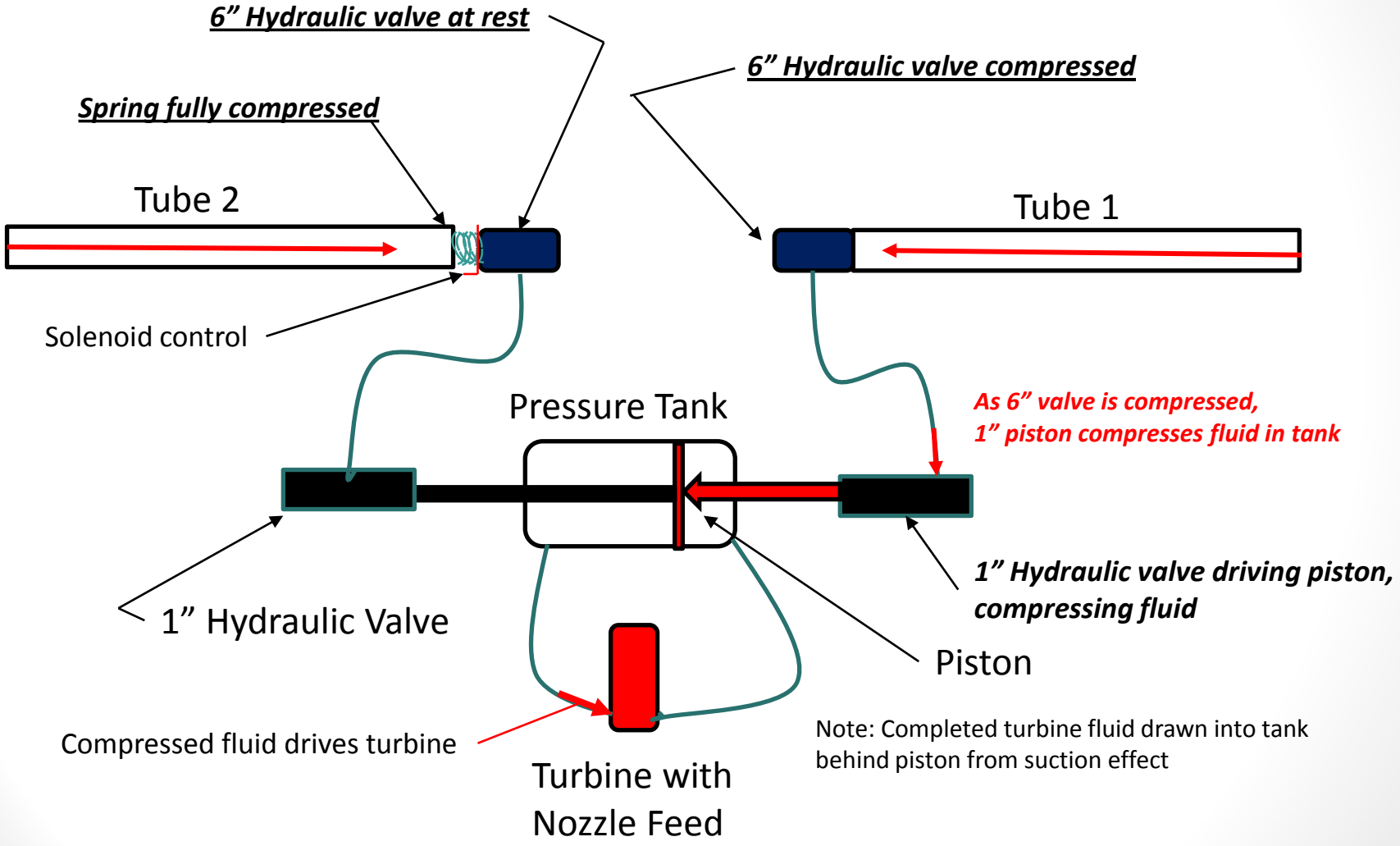
The turbine's drive vanes are spun utilizing high pressure fluid, which is generated via a nozzle (or, a diffuser). The design calls for the system to "try" and force 4 gpm into the turbine at 150 psi, but the nozzle constrains the volume due to the change in orifice size. Utilizing Bernoulli's equation to design and calculate the pressure in the nozzle, it can be seen that a nozzle with a 0.25" diameter outlet and a 1" inlet, with an inlet volume of 4 gpm at 150 psi, outputs ~.3 gpm at pressures well over 1,000 psi at initial start of each cycle, which lowers as the pressure in the tank drops, at which point the cycle stops, pressure is regenerated as the tube continues to expand, then the cycle restarts. The volume used with this design is under 15 gallons per cycle, meaning a 25 gallon tank is quite sufficient, albeit 40 gallons can be used if desired. Output in kW, using a 70% efficient turbine, is well over 5kW achieved in 4 each 20 minute cycles.

Tube Operation: (1) Starting Position



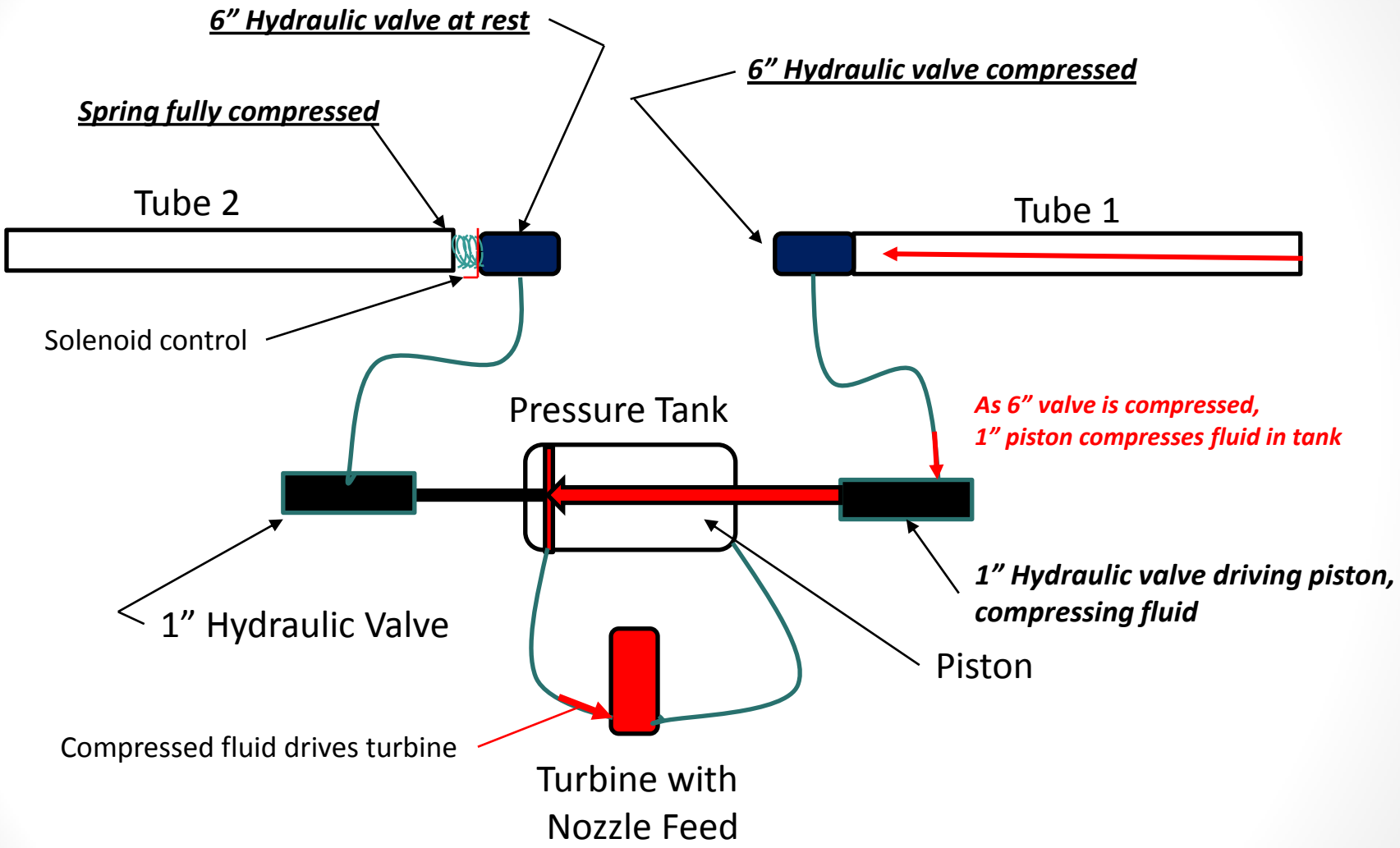
Both tubes fully “retracted”, temperature is cool

Tube Operation: (2) Tubes Heated



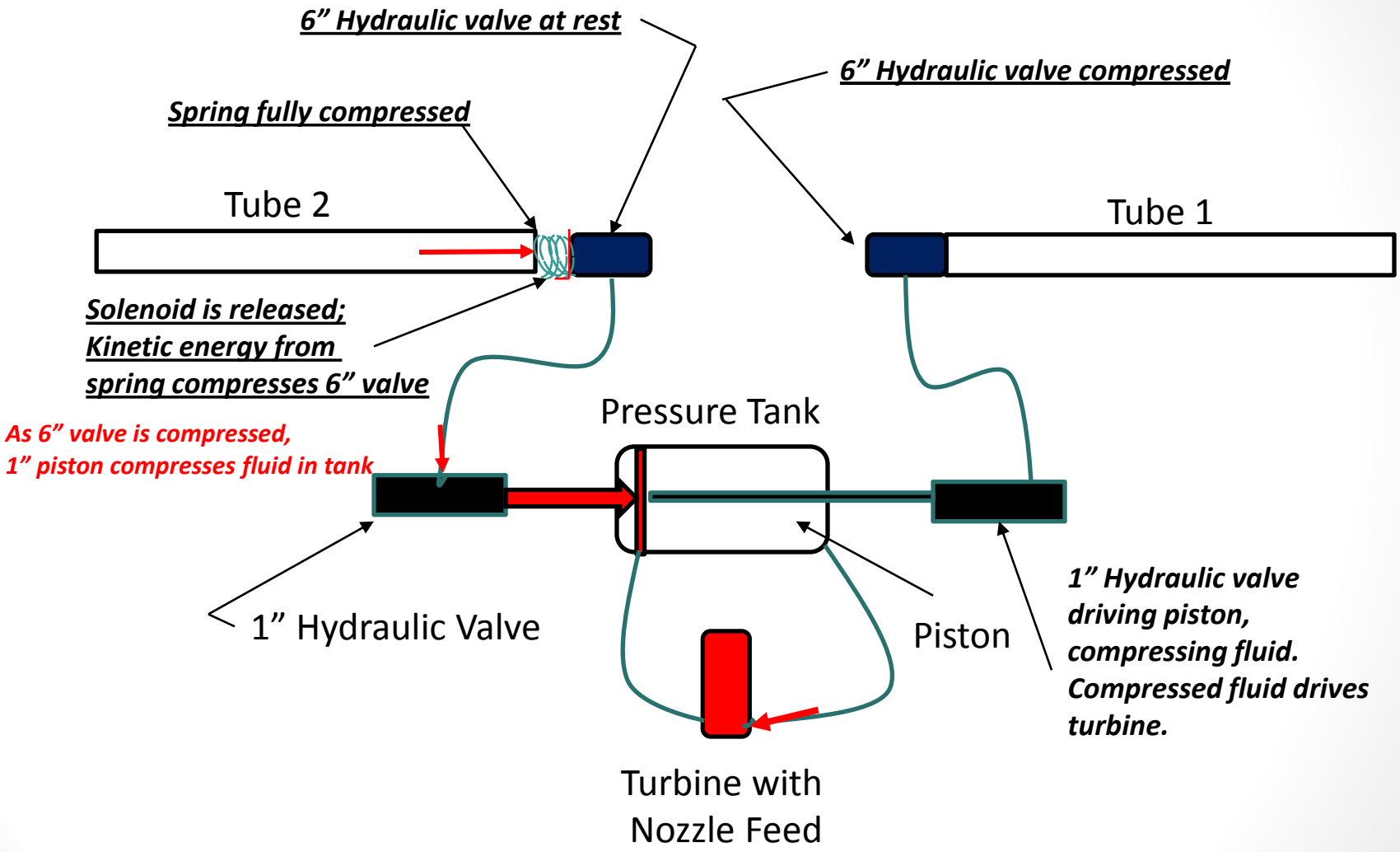
Both tubes fully “extended”, temperature is “hot”

Tube Operation: (3) Tubes at Full Extension



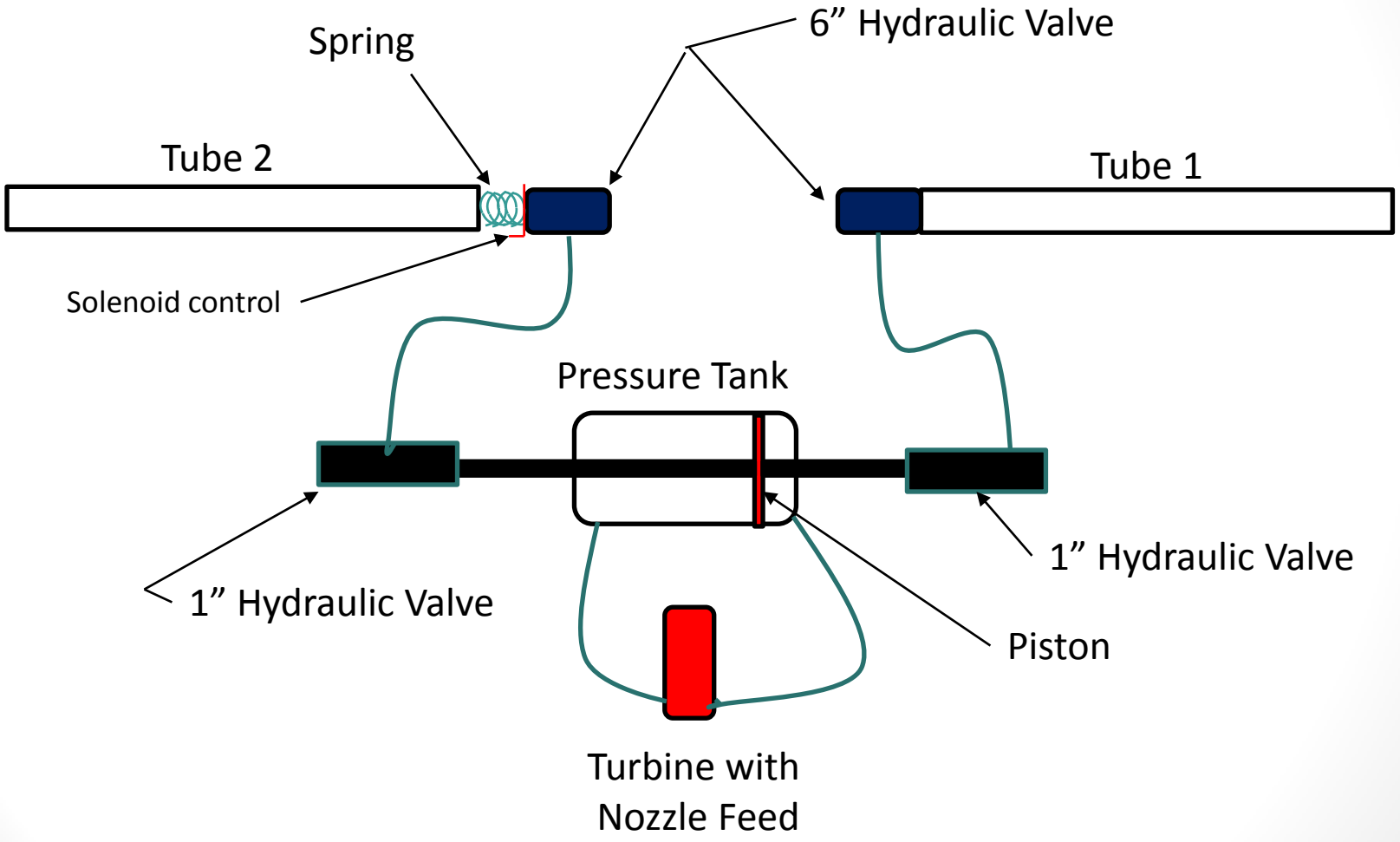
Both tubes fully “extended”, temperature is hot; turbine operates until fluid pressure is exhausted; tank is now filled on side opposite of driving direction

Tube Operation: (4) Tubes Cooled



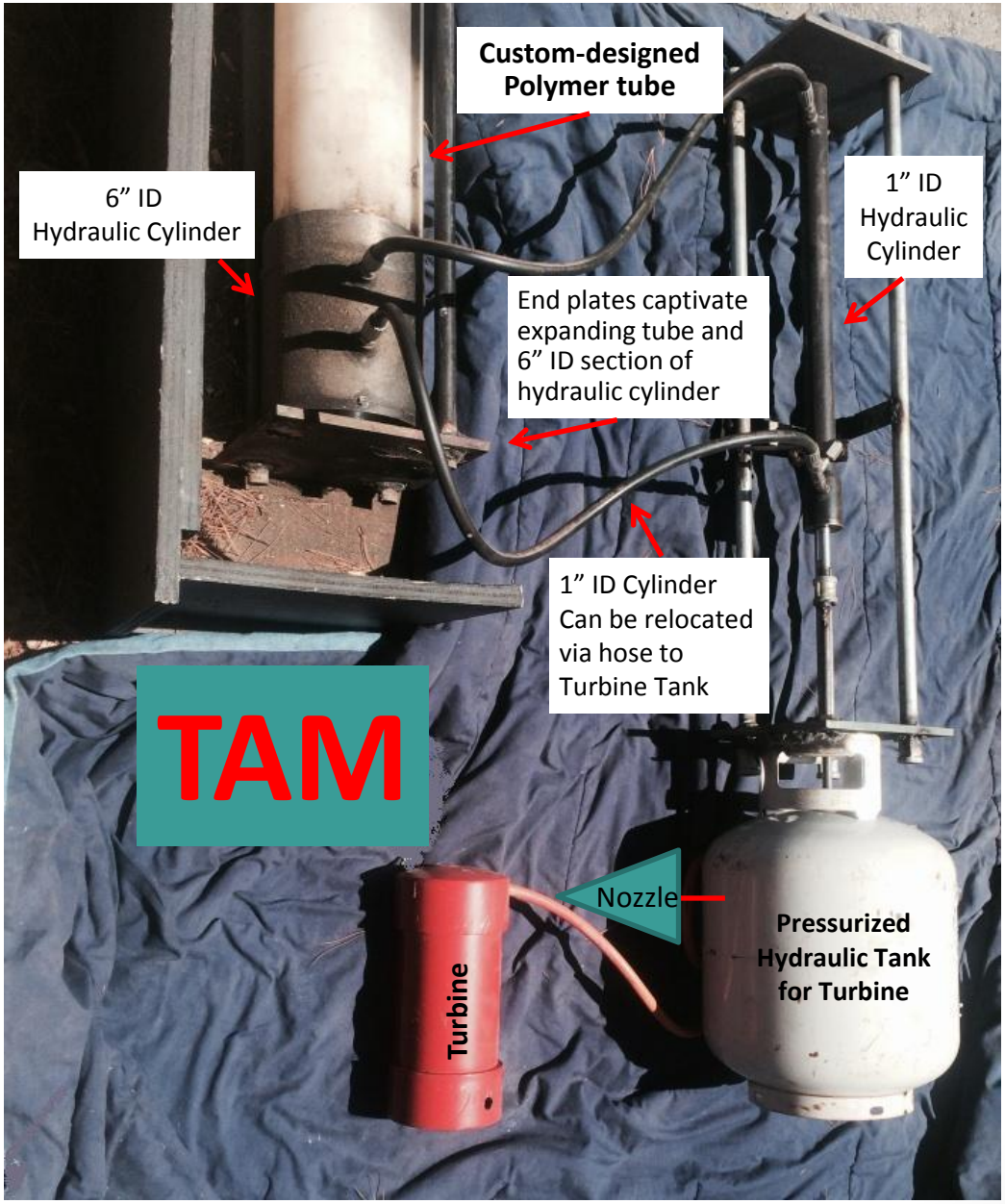
Both tubes fully “retracted”, temperature is cool; turbine operates until fluid pressure is exhausted; tank is now filled on beginning side

Tube Operation: (5) Cycle is Complete – Back to Starting Position



Both tubes fully “retracted”, temperature is cool

Actual Prototype of Invention (TAM)



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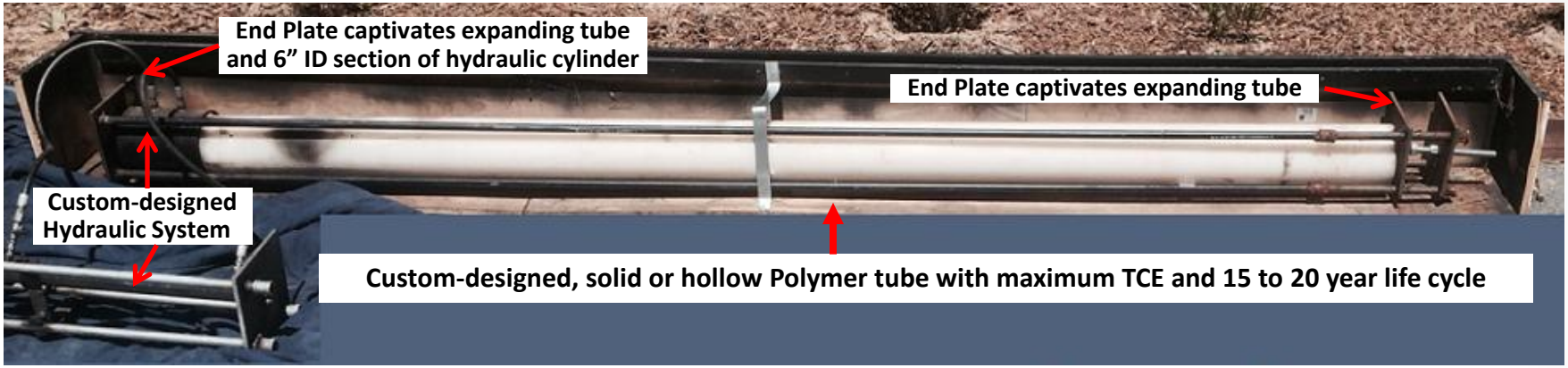
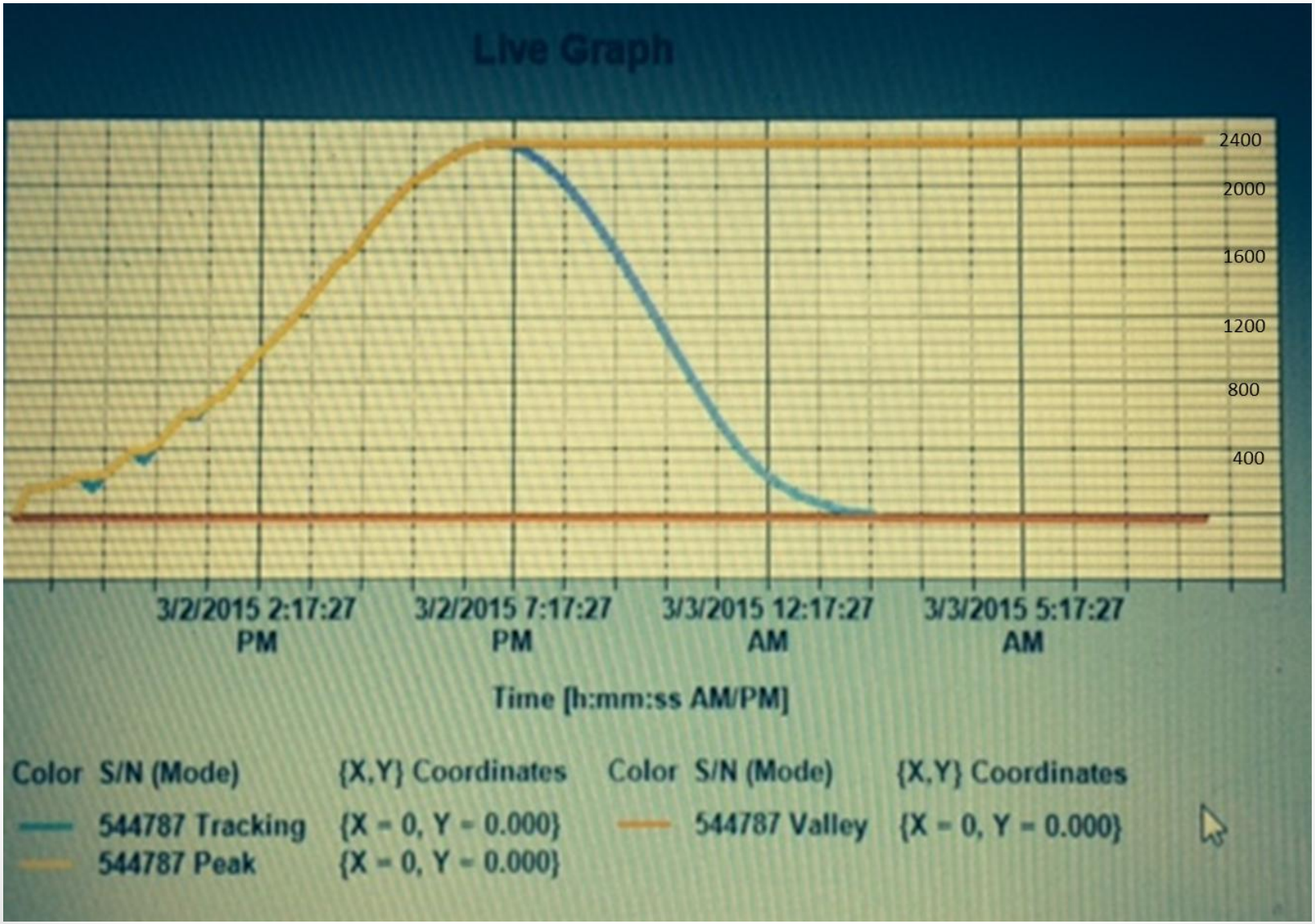
Actual Prototype of Custom Designed Tube and Hydraulic System

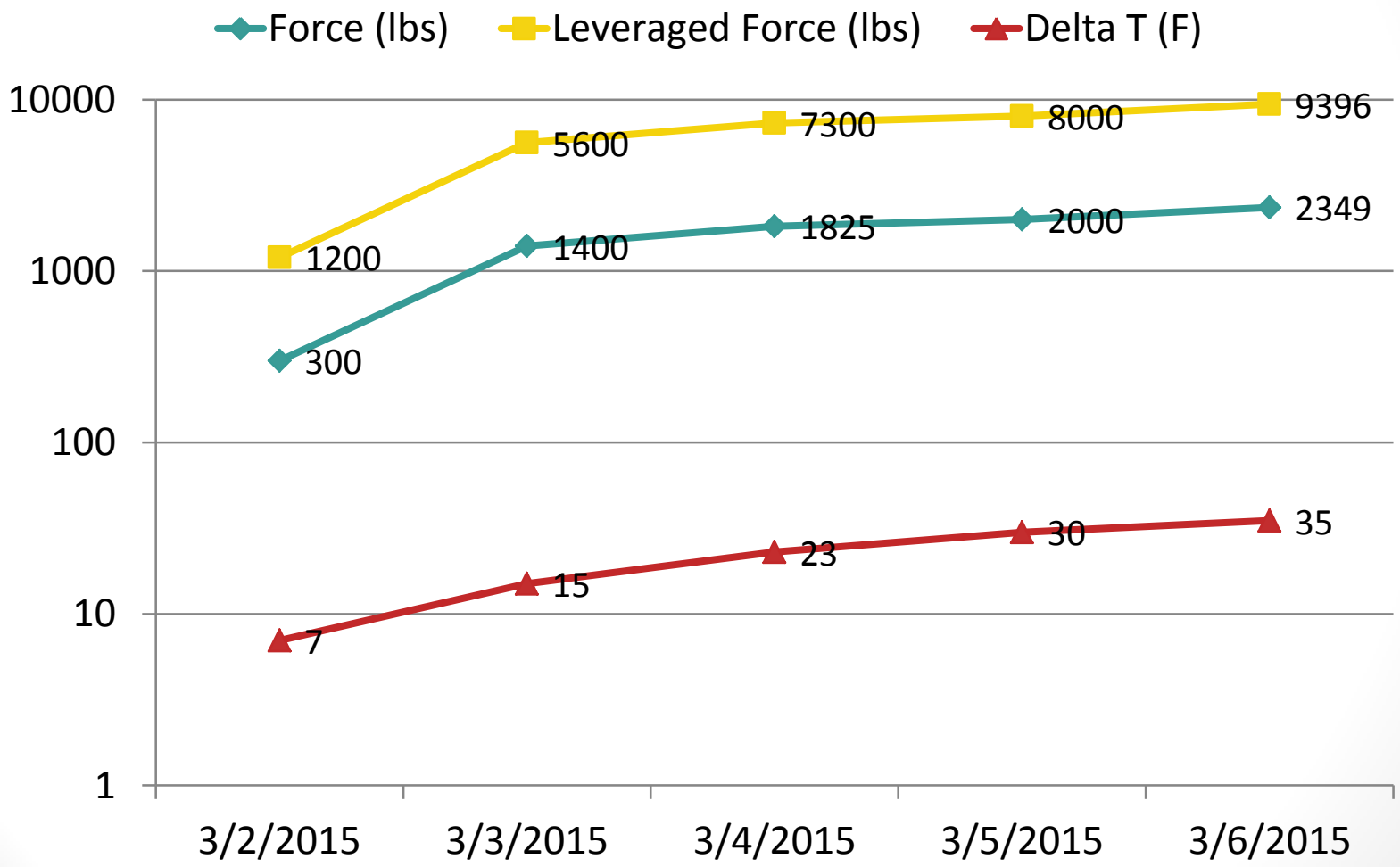


Power generation varies with number of tubes, K-force of springs, and tubes material's TCE. Using 10 foot long tubes with steel "casing" and 6" diameter hollow custom-designed tube with 1" wall thickness can generate well over 5kW of power per day.

Proof of Concept Test Results



Proof of Concept Test Results



Performance Data

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Test Type	**Configuration**	**Test Equipment**	**30-60F**	**60-90F**	**80-110F**	**Max**
			Lbs			
Tube Force	6" solid Tube and Load Cell	FUTEK Load Cell	1500	2500	4000	7000
Tube Force	6" hollow tube and load cell	calculated	1950	3250	5200	9100
6" Hydraulic cylinder	Load cell with force from solid tube	FUTEK Load Cell	1500	2500	4000	7000
6" Hydraulic cylinder	Load cell with force from hollow tube	calculated	1950	3250	5200	9100
			psi			
1" Hydraulic cylinder	Load cell with force from solid tube	calculated	40500	67500	108000	189000
1" Hydraulic cylinder	Load cell with force from hollow tube	calculated	52650	87750	140400	245700
			psi			
PSI in 25 gal. tank	Load cell with force from solid tube	calculated	800	875	950	1100
PSI in 25 gal. tank	Load cell with force from hollow tube	calculated	825	900	1000	1200
			kW			
resultant kW, 80 min. cycle	70% eff. Turbine with force from solid tube	calculated	**4.239**	**4.637**	**5.034**	**5.829**
resultant kW, 80 min. cycle	70% eff. Turbine with force from hollow tube	calculated	**4.372**	**4.769**	**5.299**	**6.359**

Force Solaire EcoPower™

- Force Solaire EcoPower™ (FS EcoPower™) is based on our breakthrough Thermal Absorption Module (TAM) designed to utilize the sun to generate massive amounts of power without solar panels.
- FS EcoPower™ is integrated with an advanced energy storage device, is highly efficient and has a small foot print. The system is scalable from 5 kilo Watts to multi-Giga Watts of power. FS EcoPower™ has a long life cycle and is virtually maintenance-free. The applications for FS EcoPower™ are limitless. The system is well-suited for residential, commercial and industrial applications; stationary and mobile, on-grid and off-grid use.
- For the first time ever, with FS EcoPower™ we will be able to provide electric power to hundreds of millions of people around the world that live without electricity today without expending trillions of dollars on power transmission and distribution infrastructure.

Force Solaire EcoPower™

The Ultimate Power Solution™

- Revolutionary New Thermal Absorption Power
  - Plug and Play Power at the Point of Use (POU)
  - No Solar Panels required
  - Ubiquitous & Infinite Energy Source
  - Works in Fog and/or Rain
  - Works on and/or off-Grid
  - Dust and Dirt-proof
  - Scalable 5 kW to Multi-GW
  - High Power Density
  - Very High Reliability
  - Maintenance Free
  - 20 Year Life Cycle
  - Recyclable
- Generates “Dispatchable” Power
- Integrated Advanced Energy Storage
- Cost-Effective and Economic
- Safe
- Patent-Pending Design
- Patent-Pending KPCS
- Patent-Pending Hydraulic System
- Patented Tube Material

Integrated Energy Storage

- Sodium Nickel Battery
  - 7.7 kWh Modules
  - 20 Year Cycle Life
  - Compact Footprint
  - Very High Reliability
  - Little Maintenance
  - Fully Recyclable
  - Cost-Effective and Economic
  - Safe

Market Size

Market Opportunity

Solar PV World Growth

- 2010: 7 GW
- 2020: 34 GW
- 2030: 105 GW
- 2040: 127 GW
- 2050: 141 GW

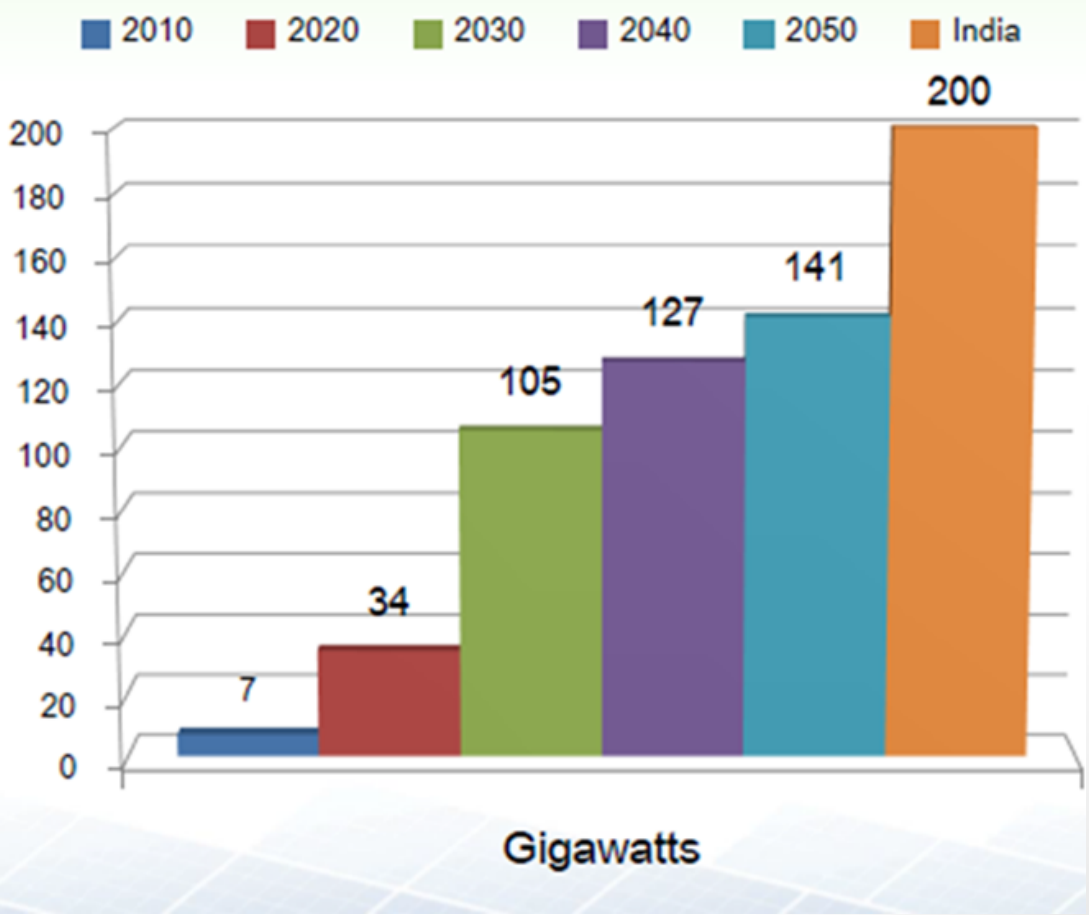
Cumulative Installed

- 2000: 1.4 GW
- 2010: 40 GW
- 2015: 196 GW*

India alone has recently projected an additional 200 GW energy demand by 2030

*EPIA Outlook 2015

Annual Growth of the PV Solar Industry



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Business Model

According to a Berkeley Lab Report from August 2013, the median installed price of PV systems completed in 2012 was:

- $5.30/W for residential and small commercial systems smaller than 10 kilowatts (kW) in size;
- $4.60/W for commercial systems of 100 kW or more in size; and,
- $2.50/W to $4/W for utility-scale systems larger than 10,000 kW.

Note: These systems do not include energy storage and therefore do not produce "dispatchable" power.

- Force Solaire's target price will be $3.00/W that includes 0.75 kWh of energy storage and will produce "dispatchable" power.
- The cost of a typical 5kW/5kWh residential system will be $15,000 before any federal and state tax credits.
- We will also offer $0 down long term leasing programs.

Target Customers for Stationary Applications

- Home owners
- Commercial and industrial users
- Utility companies for microgrids
- Renewable energy/power project developers
- Water pumping station operators without grid power, especially in small rural areas
- Desalinization plant operators
- Farmers for water pumping of farms, off-grid

Target Customers for Portable Applications

- National Disaster Resiliency Centers (NDRC), supported by the Applied Science Foundation for Homeland Security (ASFHS) to help with the recovery from catastrophic natural disasters, technological mishaps and acts of terrorism
- FEMA
  - Instant plug and play power
- DOD
  - Instant consistent power for the battle field
  - Military is currently spending about $500/gallon of diesel fuel for diesel power generators

Target Customers for Motive Applications

- Automobile Manufacturers
  - Inductive POU power plants along freeways to provide sufficient charge to maintain momentum of vehicles for EVs and Hybrids
  - Wireless, RFID triggered, vehicle charge control system
  - POU charging stations for hybrid/electric vehicles
- DOT and State Government
  - Inductive POU power plants along freeways
- End Users
  - POU charging stations for hybrid/electric vehicles

Value Proposition for manufacturers and end users:

- Eliminates concern over driving range

ForceSolaire™
The Ultimate Power Solution

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