Zero Emissions LSM Magnetic Propulsion on Standard Railway/Roadway Infrastructure

Presentation to Congressman Bob Filner
August 6, 2009
General Atomics Test Track

A presentation by:

Innovative Transportation Systems Corp.
General Atomics Electromagnetic Systems Division
AECOM

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

Proprietary Information

Innovative Transportation Systems Corp.

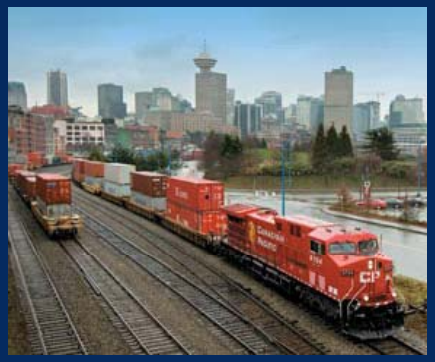
An Affiliate of Shapery Enterprises

DEVELOPING LINEAR MOTOR CONCEPTS FOR ZERO-EMISSIONS PEOPLE AND GOODS MOVEMENT

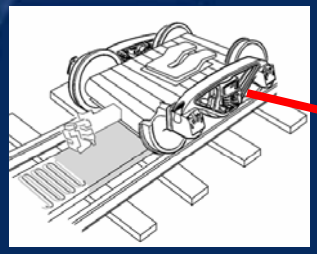
Imbedded Linear Motor Bus Transit System

Imbedded Linear Motor Trucking System

Electric LSM operated light passenger trains



Zero Emissions Electric Locomotives for Rail Yards



Multipurpose magnetic rail bogey with fifth wheel couples with trailers carrying containers to eliminate locomotive and diesel emissions at or near port terminals.

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

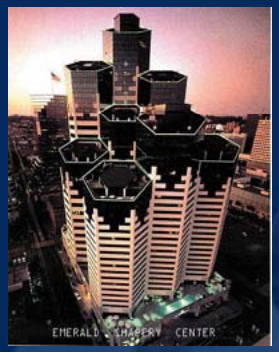
Innovative Transportation Systems Corp. (ITSC)

Collaborated with General Atomics to determined feasibility of utilizing Linear electric motors that launch fighter aircraft from aircraft carriers and applying it to moving rail cars.

The catalyst for bringing General Atomics and AECOM together.

Some other affiliates of the Shapery Group of Companies, a major commercial real estate and technology developer.

- Shapery Gyronautics Corporation
- Shapery Holdings LP
- Shapery Center Developers
- Southern California Transportation Solutions
- Columbia Funding LLC
- Shapery Developers Gas & Electric Corp.
- 12th & A Hotel Partners LP



Headquarters in San Diego, CA

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

General Atomics

- World's leader in high power linear motors.
- Founded 1955; Privately owned; 5,000 employees

UAV / Predator

Advance Sensors

Naval Ship Electrification

Electromagnetic Aircraft Launch

Fusion

Fission Reactors

Uranium Mining

Algae Synfuels

Linear Motor Transportation Maglev Systems

Streetcar Refurbishment

Mining Truck

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

AECOM Corporation

- World's largest engineering and environmental company.
- Strong international experience to effect large transportation projects.
- Representing many Ports and Railroad projects worldwide.
- Designed Alameda Corridor.
- Headquarters in Los Angeles.

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Background

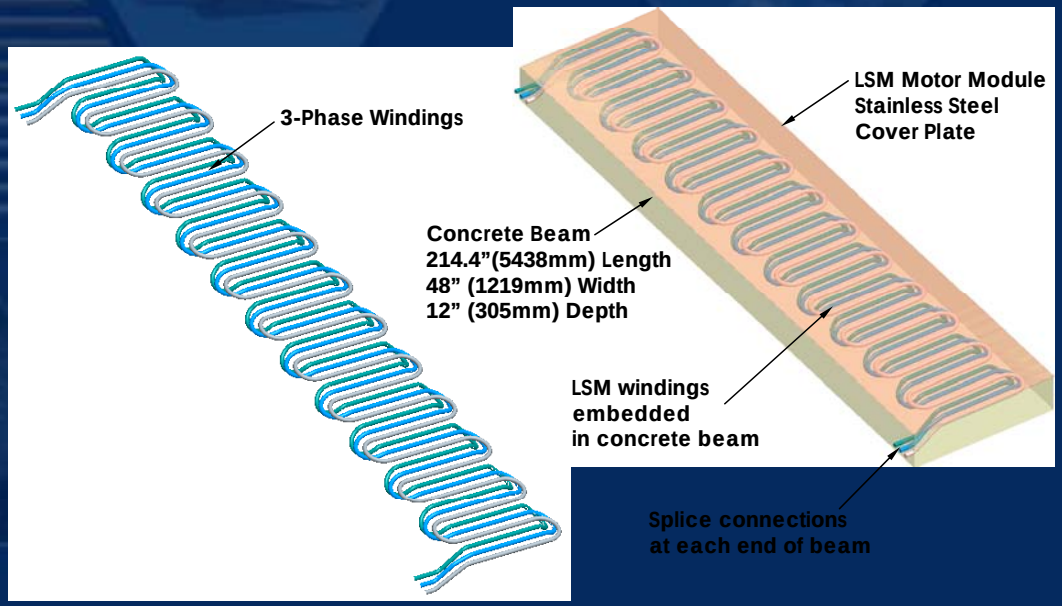
- Sandor Shapery, President and Founder of ITSC, collaborated with General Atomics to determined feasibility of utilizing Linear electric motors that launch fighter aircraft from aircraft carriers and applying it to moving rail cars.

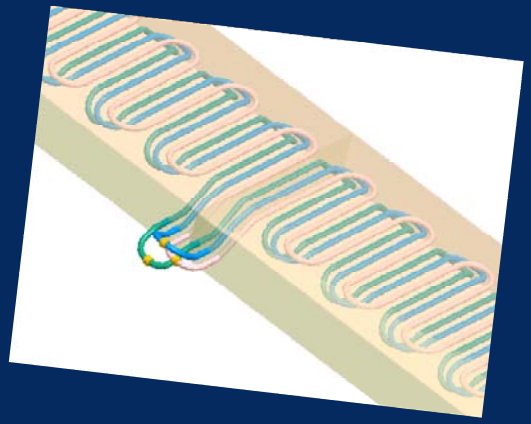
AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Key Building Block is Linear Synchronous Motor (LSM):





*** Patent Pending**

Wind LSM Cables → **Encase in Concrete/Composite** → **Join Modules**

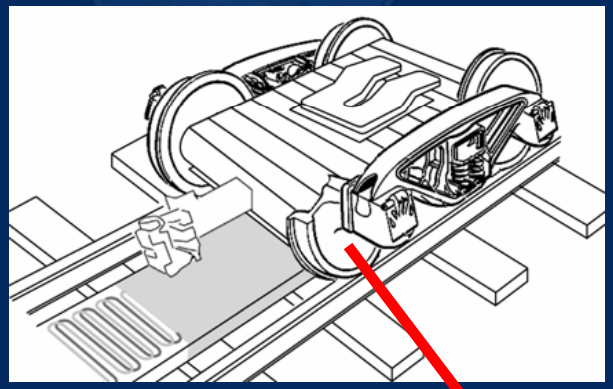
- Simple modular design – minimum impact during construction
- Efficient electric linear motor – minimizes operating costs
- No moving parts – minimizes maintenance costs

AECOM

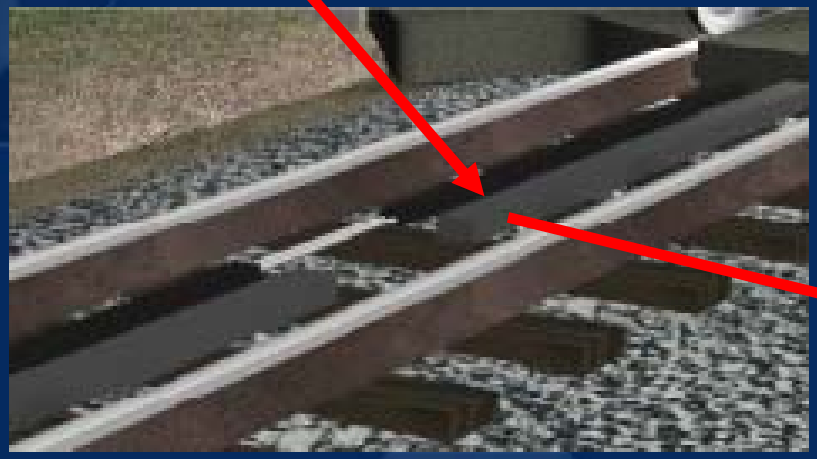
Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

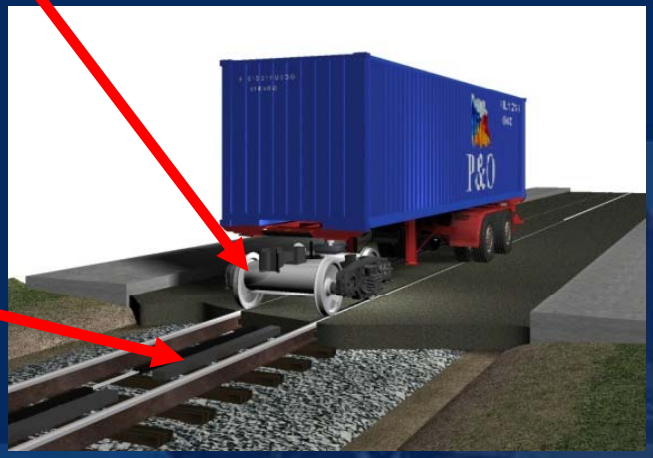
GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

Using Existing Railway Infrastructure is a Lower Cost Solution



Linear motor embedded in middle of existing railway track





Magnetic rail bogey can be used to transport standard truck trailers

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Zero Emissions Container Mover System for Transporting Container from On-dock Terminals to Inland Near-dock Terminals

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Linear Motors for Roadways

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

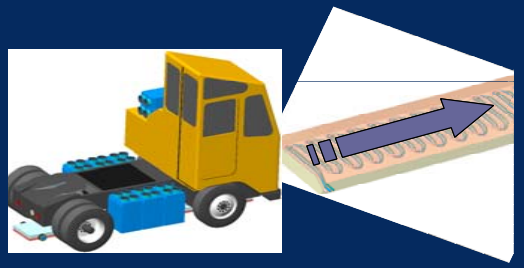
GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

LSM –Truck and Bus Technology

- Linear motor imbedded below road surface propels the vehicle and charges the vehicle's battery (energy storage system) while vehicle is automatically transported.
- A vehicle can travel some distance over embedded LSMs on roadways then for a distance without, while powering on its own batteries.

Drive over LSM to propel
And charge battery

Leave LSM and continue
using only vehicle's battery



Drive back onto LSM portion
of roadway for recharging

Increases productivity by eliminating long charging downtimes.

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Emissions Reduction Potential

35,605 tons per year of emissions can be eliminated in the San Pedro Bay ports region by converting 1.2 million truck trips/year to a zero emissions container moving system, according to a Port of Los Angeles staff study.

Fuel Reduction Potential

Net fuel savings per year can be $9.2M per year.

Truck Fuel Cost $10.8M – LSM Power Cost $1.6M = $9.2M

Diesel fuel cost from truck drayage.

Ave. 15 miles RT from all terminals / 5 miles/gal. = 3 gal./trip

3 gal./trip x 1.2Mil. Trips = 3.6 Million gallons

3.6 Million gals. X $3.00/gal. = $10.8M/year fuel cost

Electricity cost of LIM/LSM

0.5 lb diesel/Hp-hr → 14 Hp-hr.gal → 10.6 kWhr/gal

400 ton-miles/gal over 500 million miles = 13.3m kWhr

13.3M kWhr x $0.12/kWhr = $1.6M/year electricity cost

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

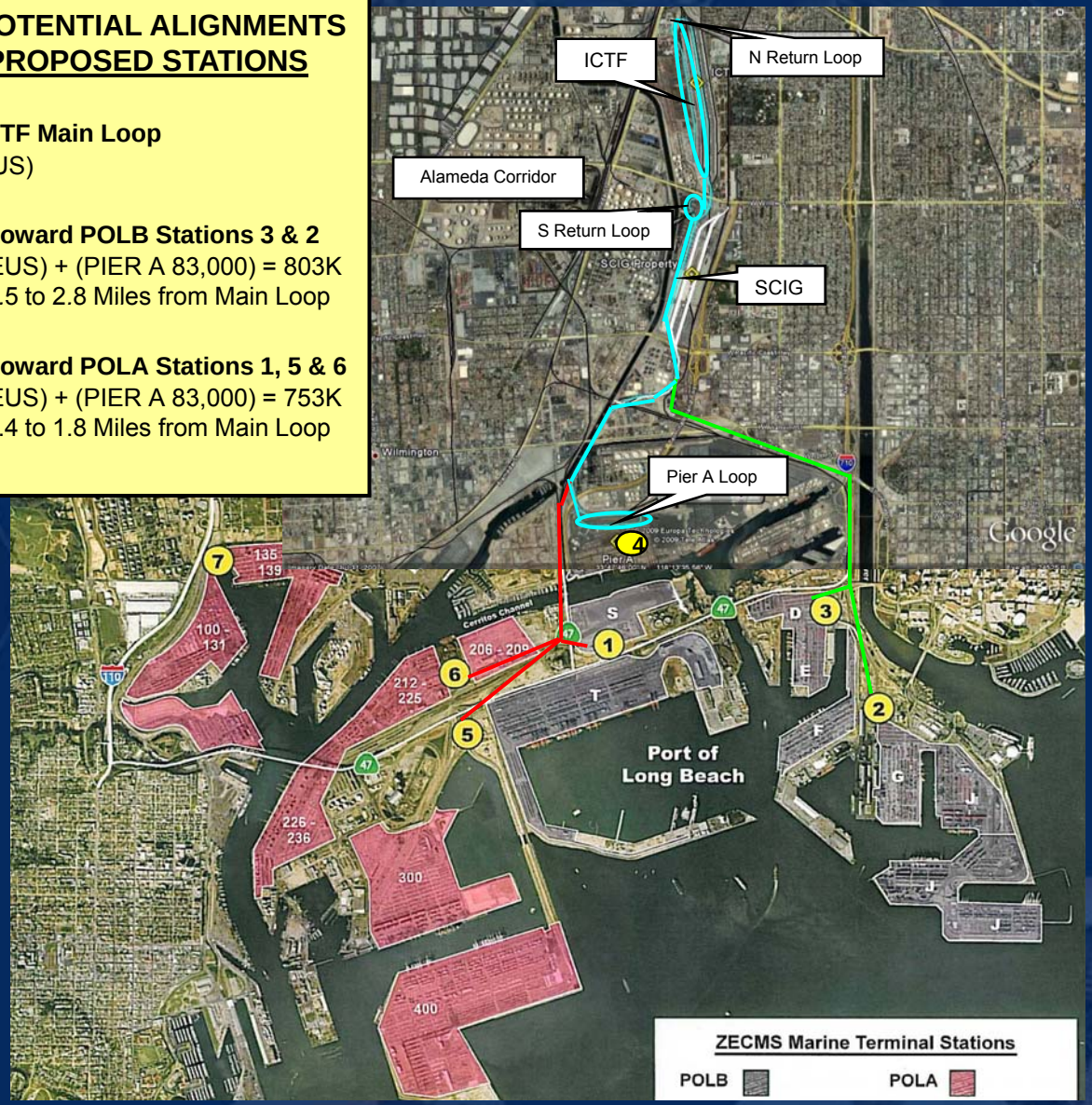
GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

ITSC ZECMS POTENTIAL ALIGNMENTS AND RFCS PROPOSED STATIONS

Pier A to ICTF Main Loop
(83,000 TEUS)

Extension toward POLB Stations 3 & 2
(720,000 TEUS) + (PIER A 83,000) = 803K
Additional 2.5 to 2.8 Miles from Main Loop

Extension toward POLA Stations 1, 5 & 6
(670,000 TEUS) + (PIER A 83,000) = 753K
Additional 1.4 to 1.8 Miles from Main Loop



AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

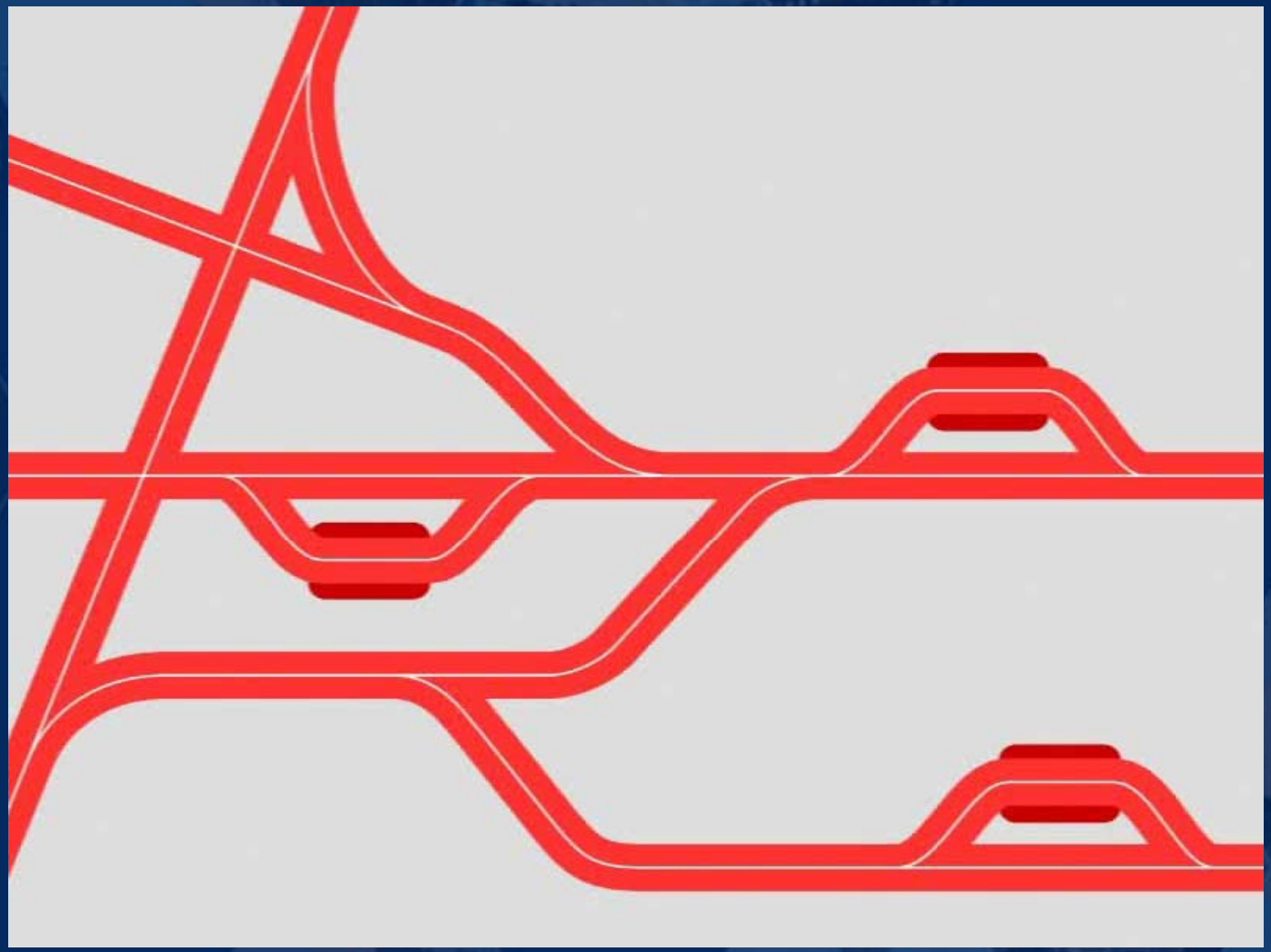
LSM Drive Characteristics
Preliminary Analysis - The Virtual train

- Independent remote or on board control of each vehicle
- Magnetic propulsion and regenerative braking reduces energy cost by as much as 75% under certain operating conditions.
- Only one vehicle allowed per track section – collisions impossible.
- Reliable - no moving parts
- Force is applied directly to vehicle
  - Reduces wear on wheels and rails
  - High performance (acceleration, velocity)→ High Throughput
- Complete control over acceleration and velocity
- Quiet – no engine noise.
- Capital cost comparable to electric overhead conversion

LSM adaptation from manufacturing

Video courtesy of MagneMotion Corp.

Virtual Train



Technology Maturity

Linear motor goes back 100 years when first described by Robert Goddard in 1905. He went on to become the father of the liquid fuel rocket.

Emile Bachelet, a French engineer applied for a patent in 1910 for a magnetically levitated railroad car.

Linear motors have been used in rail systems:

- Vancouver Light Rail System
- Kuala Lumpur Transit
- JFK AirTrain
- Detroit People Mover
- Scarborough Light Rail, Toronto
- Shanghai TransRapid System

The Shanghai Transrapid LSM (long-stator) system has proven highest reliability factor of all existing LIM-based rail systems running at 99.1% and is the most reliable public transportation system in the world.

Also proved that the long-stator system of putting motor windings on quide-way instead of vehicle is less costly over all.

JFK AirTrain

Shanghai TransRapid

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

GA Transportation Technology: Evolution from Maglev to LSM Rail, Bus and Truck

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009

Urban Maglev Program

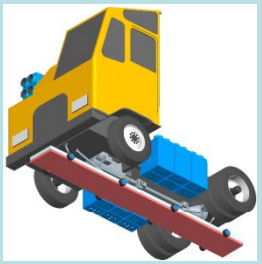
- Funded by FTA and Penn DOT, with GA cost share
- Licensed Livermore "Halbach Array" maglev technology
- 400-foot test track demonstrates proof-of-concept in 2004
- Developed levitation, propulsion, guidance, control, and ATP

Electromagnetic Cargo Conveyor (ECCO)

- ECCO concept using maglev for goods movement originated by CSULB
- Developed for port applications using same GA passive maglev ("Halbach Array") technology as Urban Maglev Program

Existing Infrastructure Solutions

- Concepts using existing rail (MagneTrack™)
- Concepts that can operate at port terminals
- Concepts that can operate on existing roads (MagneTruck™)



AECOM

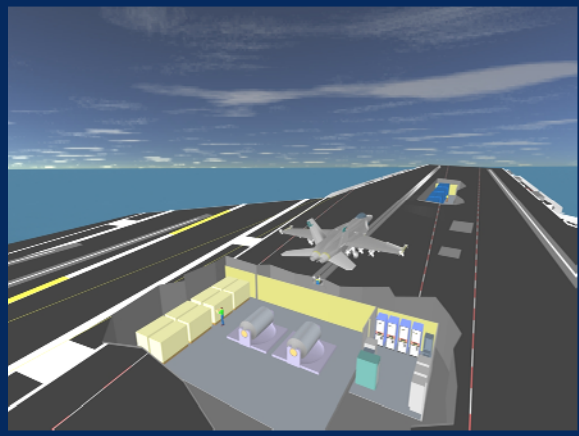
Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

LSM for rail and bus transportation systems leverages major commercial and military technology investments

Inverters for 400-ton mining trucks, light and heavy rail

Linear electric propulsion, control, and train protection systems for ECCO Maglev



Launch systems with 50-year design life in full-scale development

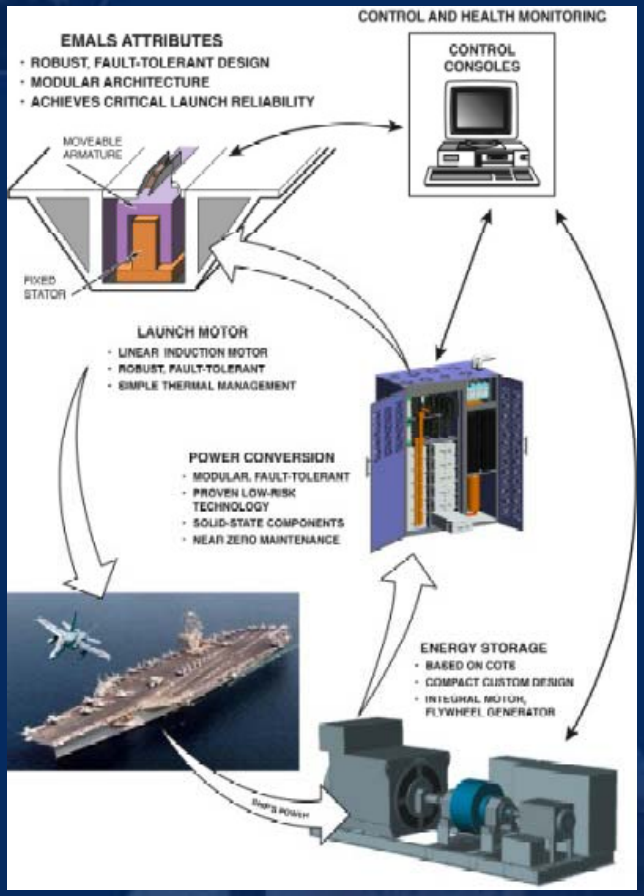
AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

System Reliability

- Root of system design stems from General Atomics work for military on the Electro-Magnetic Launching System (EMALS).
- EMALS will be part of newest aircraft carriers, where a 78,000 lbs. fighter jet will be launched accelerating from 0 to 200 mph in under two seconds.
- System has reliability far beyond what is required for ground based transportation operations.
- Patented fail-safes will be applied to transportation systems.



AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS ELECTROMAGNETIC SYSTEMS

Value Proposition / Public Health-Public Safety

- Reduction of energy costs as diesel fuel is four times more costly per energy unit than electricity from a stationary power plant.
- Reduction of pollution as diesel engines produce 120 to 240 times more particulate pollution and NOX than a stationary power plant.
- Reduction of costs to the public of lost time, wages and health resulting from the effects of pollution, thereby increasing public health benefits.
- Low installed cost and Low operating and maintenance costs

Market Potential

- **Freight**
  - Railroads
  - Trucks
  - Port terminals
  - Intermodal railyards

- **Passenger Rail**
  - Metro
  - Light Rail
  - Commuter Rail

- **Autos / Trucks / Buses**
  - Auto lanes
  - Truck lanes
  - Bus lanes

AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

MagneTrack™ Applications

Zero Emissions Container Transport System for Ports

Zero Emissions Rail yard Operations - Moving Rail Cars and Constructing Train Consists

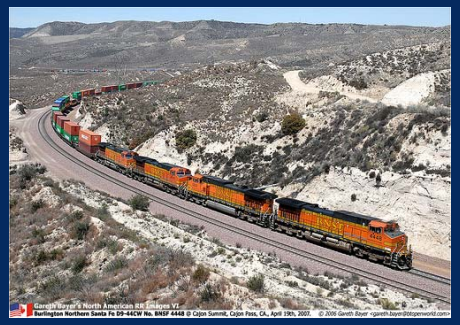
Zero Emissions Passenger Rail Without Unsightly Overhead Catenaries

Recapture of Energy on Downhill Train Operations into Grid and Reuse of Energy to Assist in Uphill Operations

Zero Emissions for Trains Traveling Through Long Tunnels

Zero Emissions Train Locomotives

Possible to add capacitors, batteries and an electric power drive on wheels that would allow bogie to operate on and off of the linear motor rail section.



AECOM

Innovative Transportation Systems Corp.
An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS