Zero Emissions LSM Magnetic Propulsion on Standard Railway/Roadway Infrastructure

Presentation for California Energy Commission – Electric Drive Infrastructure Workshop
October 12, 2009

A presentation by:

Innovative Transportation Systems Corp.
General Atomics Electromagnetic Systems Division
AECOM

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An affiliate of Shapery Enterprises

GENERAL ATOMICS
ELECTROMAGNETIC SYSTEMS

Innovative Transportation Systems Corp. (ITSC)

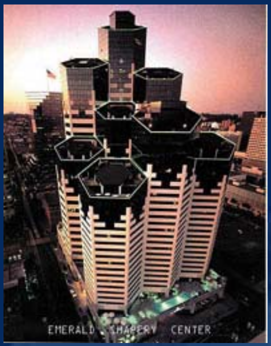
Collaborated with General Atomics to determined feasibility of utilizing Linear electric motors that launch fighter aircraft from aircraft carriers and applying it to moving rail cars.

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



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General Atomics

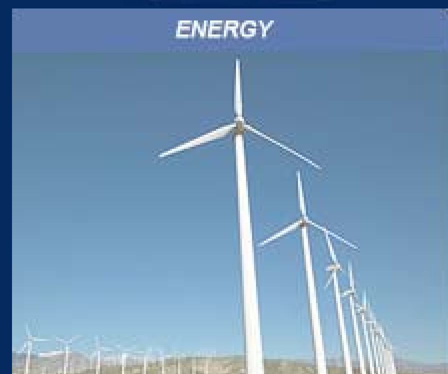
- World's leader in high power linear motors.
- Founded 1955; Privately owned; 5,000 employees

UAV / Predator

Advance Sensors

Naval Ship Electrification

Electromagnetic Aircraft Launch



Fusion

Fission Reactors

Uranium Mining

Algae Synfuels

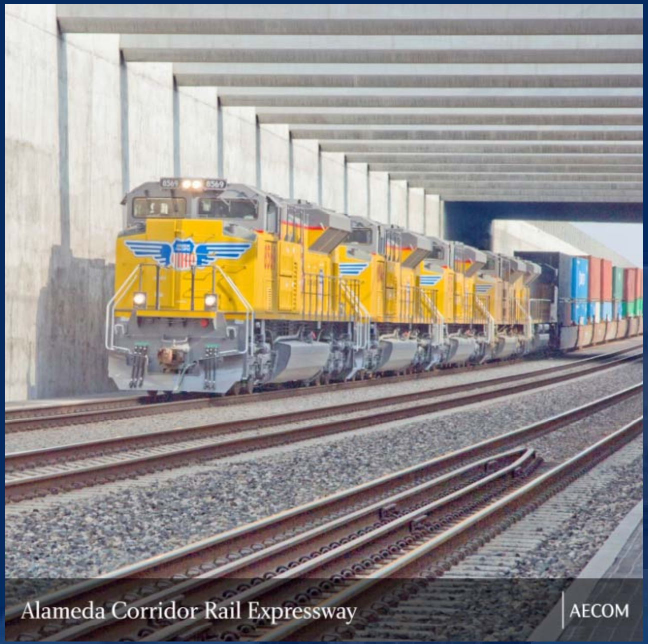
Linear Motor Transportation Maglev Systems

Streetcar Refurbishment

Mining Truck

AECOM 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.



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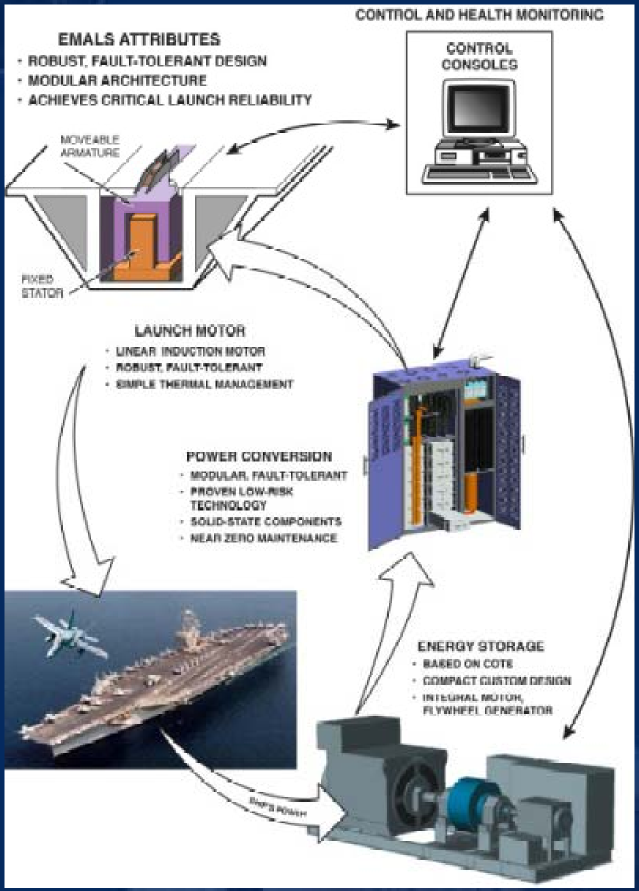
Evolution from Military Application

- 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.

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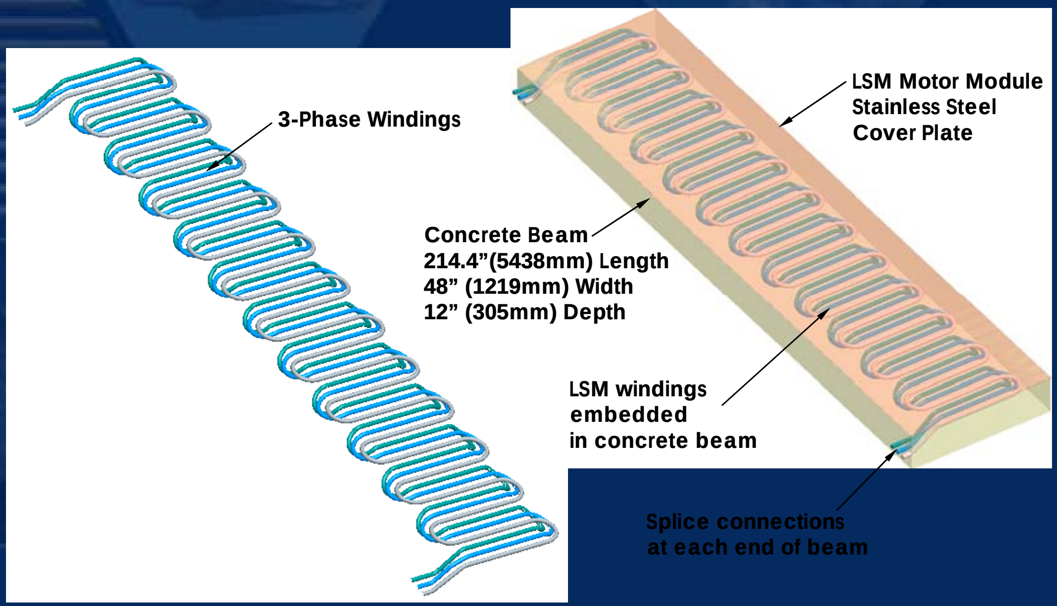
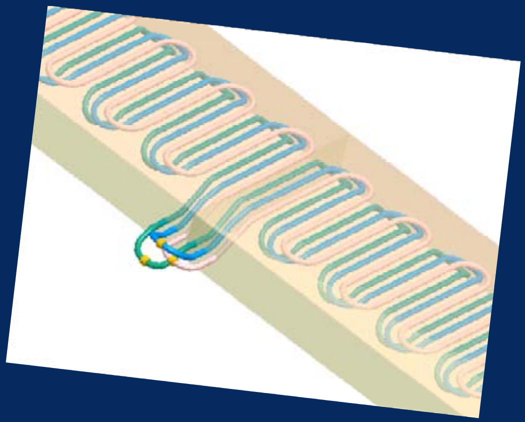
Key Building Block is Linear Synchronous Motor (LSM):





* 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

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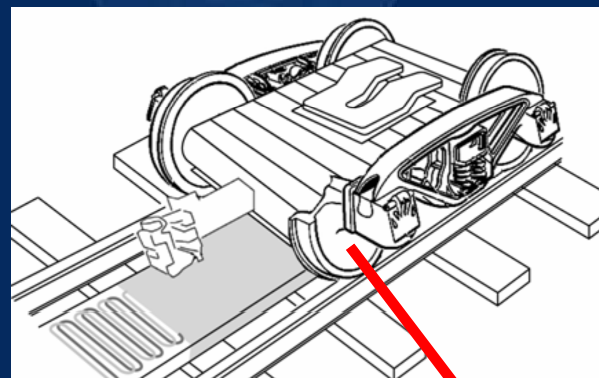
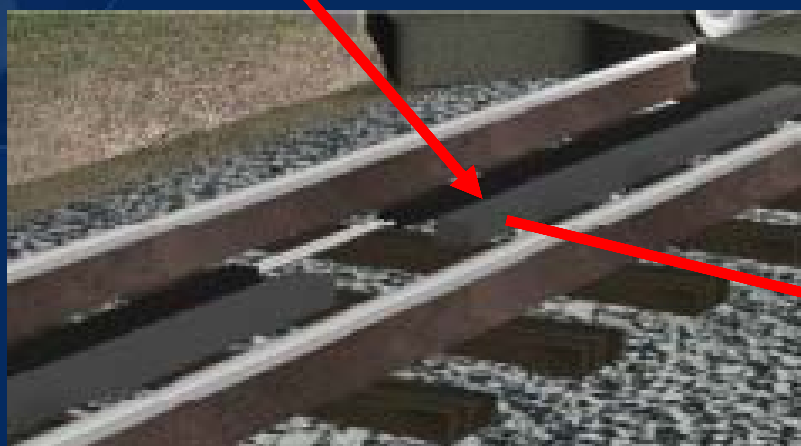
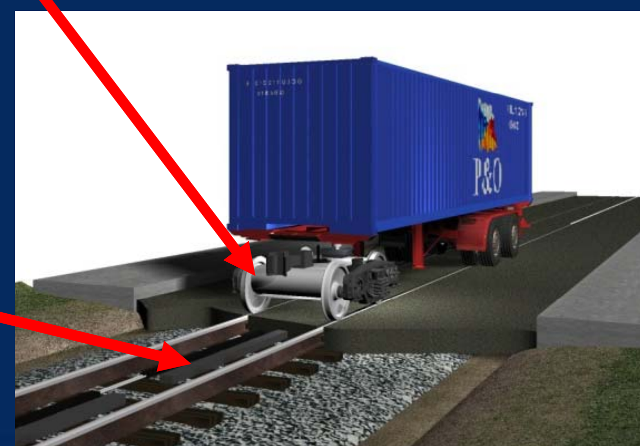
Using Existing Railway Infrastructure is a Lower Cost Solution



Linear motor embedded in middle of existing railway track





Magnetic rail bogey can be used to transport standard truck trailers

Proprietary Information

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

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To complete the solution ITSC's LSM system is capable of inductively charging

Ideal for truck drayage from Ports to near and off-dock terminals.

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

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

JFK AirTrain

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.

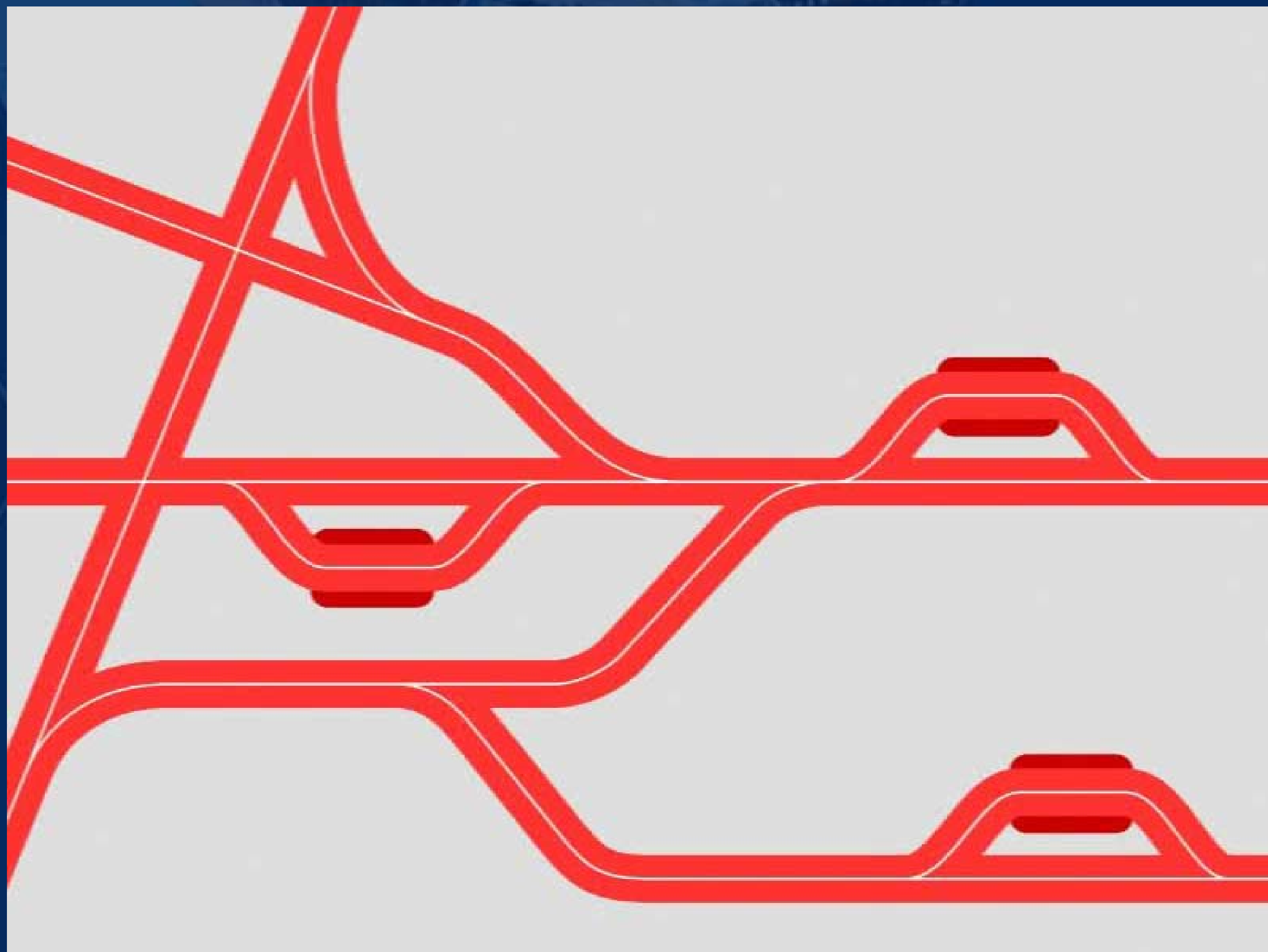
Also proved that the long-stator system of putting motor windings on quide-way instead of vehicle is less costly over all.

Shanghai TransRapid

LSM adaptation from manufacturing

Video courtesy of MagneMotion Corp.

Virtual Train



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Development Plan

- Phase 1 – Design/Build Demonstrator -12 Months
- Phase 2 - Design Development to Permits - 24 Months
- Phase 3 – Financing Plan
- Phase 4 – Construction and Operation - 30 Months

Phase 1 – Funding Sources to Build Demonstrator

- Secure location for proof of concept demonstrator.
- Obtain partial funding from Federal and/or State grants and match with regional and/or local agencies (i.e. AQMD, CARB).
- Supplement / match government funding with private in-kind contributions (i.e. land; equipment; etc.).
- Develop demonstrator working drawings for permits.

Phase 2 – Design Development Funding to Permits

- Win RFP to develop system for ports.
- Additional grants/loans (TIFIAA, ARRA)/in-kind contributions.
- Detailed design for operating system.
- Initiate environmental studies and impact reports.
- Develop community and user outreach program – Create an Advisory Committee.
- Negotiate long-term operating contract.

Phase 3 – Financing Plan

- Private financing available upon receipt of all development permits.
- Determine operating income and expenses.
- Determine capital costs.
- Develop financial business plan.
- Determine if public sector funding needed to cover possible shortfalls.

Phase 3 – Preliminary Financial Pro-forma

- Step 1 – Demonstrator cost = $8 M
  (public funding/private in-kind contributions)

- Step 2 – Design development = $22 M
  (public funding/private in-kind contributions)

  Total predevelopment costs = $30 M

- Step 3 - Construction = $468 M
  (Privately funded) (No grid upgrade required)

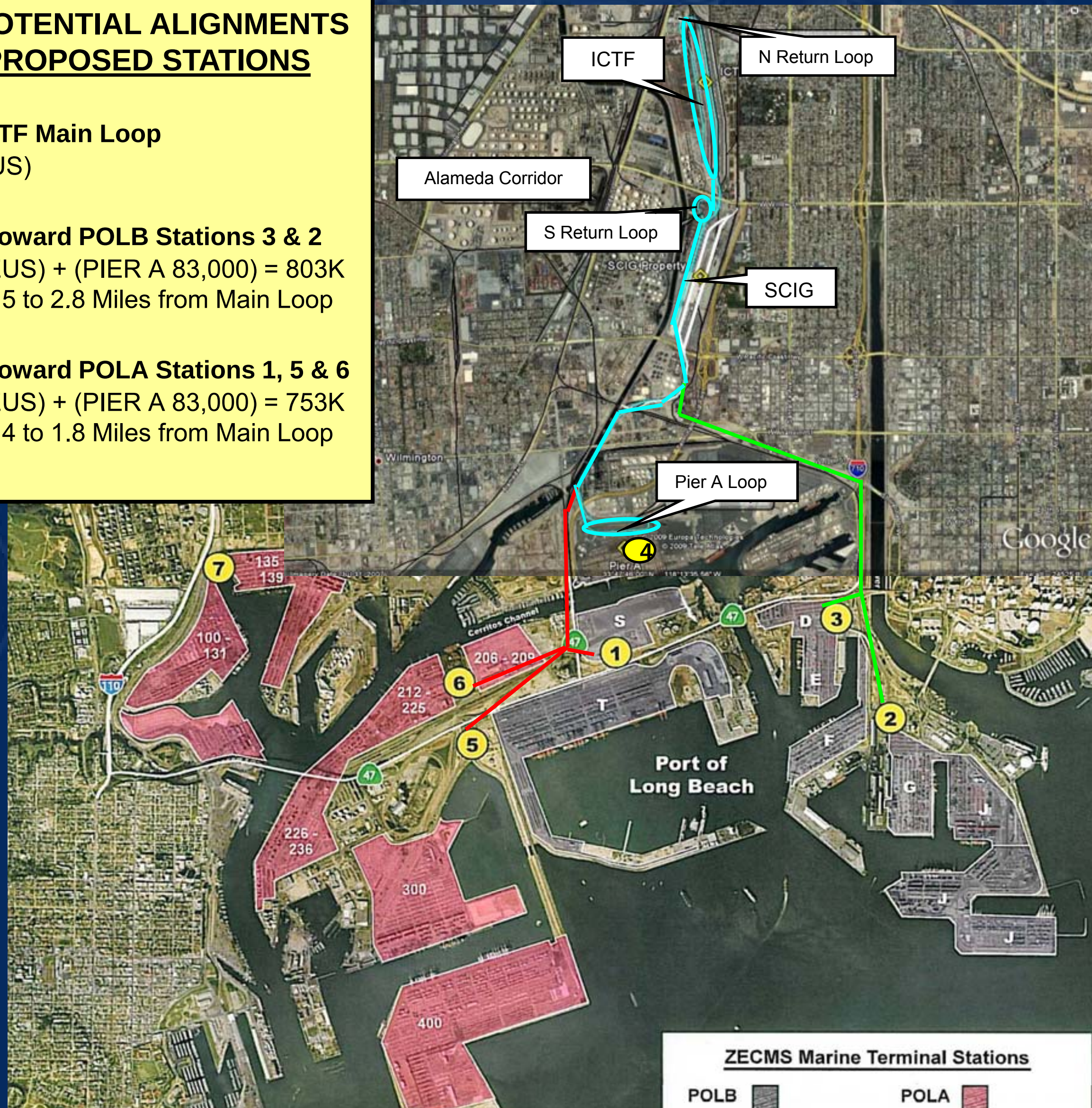
Comparable systems (Maglev) $50 to $100 M per mile = $1.2 to $2.4 Billion)

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



Phase 4 - Operations

Proprietary Information

Preliminary Pro-forma First Year (At current trucking costs)		Preliminary Pro-forma Yearly Average of 24 Years (At 15% discount to current trucking costs; not adjusted for inflation)	
Revenue ($75/Cont. x 900K containers)	$69 M	Revenue ($65/Cont. x 1.3 M containers)	$84.5 M
Labor Costs ($3.5M/yr/station x 6 stations)	$21 M	Labor Costs ($3.5M/yr/station x 6 stations)	$21 M
Energy Costs	$1.2 M	Energy Costs	$1.2 M
Overhead and Profit 15%	$10.35 M	Overhead and Profit 15%	$12.68 M
Gross Income	$36.45 M	Gross Income	$49.62 M
Capital Costs Debt Service ($19.5M x 24 miles = $468M)	$35.5 M	Capital Costs Debt Service ($19.5M x 24 miles = $468M)	$35.5 M
Income Available to Retire Predevelopment Loans	$950 K	Income Available to Retire Predevelopment Loans	$14.12 M

Questions?

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