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## AGS Feasibility Study Meeting Notes

**Meeting Type & Number:** PLT Meeting #9  
**Meeting Date:** March 14, 2013  
**Meeting Time:** 10:00 AM to 1:00 PM  
**Location:** Elks Lodge, 1600 Colorado Blvd., Idaho Springs, CO  
**Prepared by:** Mike Riggs  
**Date published:** March 27, 2013  
**Attendees:**

<b>Attendees ( * - PLT Member, ** - PLT Alternate)</b>		
Eva Wilson, Eagle County*	Mary Jane Loevlie, I-70 Coalition*	Flo Raitano, Summit County*
Maria D'Andrea, Jefferson County*	Peter Lombardi, CDOT*	Tom Breslin, Clear Creek County*
Cynthia Neely, Clear Creek County**	David Krutsinger, CDOT DTR*	Terri Binder, Club 20*
Tim Mauck, Clear Creek County*	Angie Drumm, CDOT*	Mike Riggs, AZTEC/TYPSA*
Danny Katz, CoPIRG*	Jill Ryan, Eagle County**	Kerry Anne McHugh, Town of Georgetown*
Nick Farber, HPTE	Pamela Bailey-Campbell, Jacobs	Steve Smith, Parsons
Miller Hudson, CMG	Beth Vogelsang, OV Consulting	Phil Buckland, Clear Creek County
Mandy Whorton, CH2M Hill	Jose Luis Arevalo, TYPSA	Ed Romero, Romero & Wilson
Joaquin Barba, TYPSA	Tom Underwood, Jacobs	Kevin Coates, AZTEC
Ralph Trapani, Parsons	Anne Callison	Henry Hollendar, Representing Rep. Max Tyler

### 1. Introduction to the Meeting

David Krutsinger opened the meeting and welcomed the PLT. All attendees introduced themselves.

Mike reviewed the meeting agenda and outlined the meeting objectives, which included:

- Present preliminary alignments to PLT
- Update on Stations/Land Use Meetings
- Answer PLT's questions about Maglev performance
- Update on Funding and Financial Workgroup progress
- Update on AGS/ICS/Co-Development project coordination

### 2. Public Comment

Miller Hudson spoke about the Colorado Maglev Group (CMG) which is advancing the General Atomics' maglev technology as a possible solution for the I-70 corridor. At their initiative, they are conducting a cost estimate for the project that will be released by end of April. They believe the cost of the system will determine whether this is a feasible project or not. They invite the consultant team or any other interested parties to travel to Pittsburg to review the cost estimate with their team. A private party is interested in doing this project, they think it can be done, and they think it can be paid for. If there's another Federal Transportation Budget, there may be money available, and CMG wants to ensure that Colorado is in line for that funding. General Atomics' technology will be installed on the first crop of aircraft carriers next year using the

same motor used in FTAs urban maglev study. It will be a replacement for steam catapult systems on aircraft carriers..

### 3. Preliminary Alignments

Mike Riggs explained the current alignment design effort. Four alignments are being developed:

- Wholly inside I-70 right of way alignment (except to get to stations outside right of way) – this alignment is suited for low speed maglev such as American Maglev.
- Greenfield alignment for high speed steel wheel on rail – this is suited for technologies such as Talgo.
- Greenfield alignment for high speed maglev – this is suited for technologies such as Transrapid.
- Hybrid alignment that combines alignment within I-70 right of way with improvements to make it faster by removing substandard curves and leaving highway in places to shorten distance between stations.

Mike pointed out that these are preliminary alignments that have yet to be optimized for station location. All stations except for Golden (Suburban West per ICS) and Eagle County Regional Airport (ECRA) are still being considered. These two stations are givens as they are at beginning or end of alignment.

Environmental impact review on these alignments still needs to be conducted.

Mike Riggs, Jose Luis Arevalo and Joaquin Barba presented the alignments.

#### **Greenfield Alignment for High-Speed Rail**

From Golden to ECRA, there is about 101 miles of double tracks. The alignment needs to be flat and straight, with a maximum 2.3% grade to allow for acceleration of trains. There is almost 65 miles of tunnels in this alternative, and one tunnel is 19.2 miles long.

These original alignments will change as details are examined during the process.

TYPSA has its own software to model how a train behaves in each alignment. At a 3% grade, the train could not accelerate so the 2.3% grade is used (similar to the grade in the EJMT).

As with most high speed rail alignments in a mountainous area, alignment will consist of tunnels linked by bridges. This is especially true through Clear Creek Canyon.

The majority of the initial alignment is not at grade. The first nine miles of the alignment is mostly in a tunnel.

The design speed is 150 mph, which means the train can reach this speed after accelerating away from stations. It takes about 2 miles to accelerate or decelerate from this speed. The average speed from Golden to ECRA will be 85 mph.

Station dwell time was considered to be 4 minutes.

220 mph in this corridor would be close to impossible.

A station was placed in Georgetown for the speed profile model considered. Heading west out of Georgetown, a 19.2 mile long tunnel takes the train under the continental divide towards Silverthorne.

A station has also been considered at Silverthorne. A spur has also been added to Breckenridge. It is not possible to go from Breckenridge to Vail due to grade issues along Vail Pass. The HSR alignment from Silverthorne to Vail is a straight line bypassing Copper Mountain.

Within Vail Valley, alignment follows I-70 and is lower speed design (100 mph). The alignment can serve either Vail or Avon or both.

PLT Questions:

Q: Would you be able to tunnel under buildings? A: It depends on the depth of the tunnel but it is feasible to tunnel under structures.

Q: In Golden, where's the station located, where does it connect, does it go through the Town of Golden? A: The Town is thinking about several station locations. There will not be a station in downtown Golden. A location for the Golden station has not been determined; there are three or four ideas that are still "on-the-table" depending on the alignment. The primary locations are at the junction of the interstates, either at the Home Depot location or the Colorado Mills location. These are the two main sites at the moment. None are located within the City of Lakewood.

Q: Does this alignment daylight at the stations? A: You can do anything regarding daylight and station locations. There are very good examples of underground stations that can be built. If an underground station has to be developed, there can be daylight integrated into the station design. An HSR station should never be developed underground in a cavern. Subways in which the station is too deep, people avoid using them.

### **Greenfield Alignment for High-Speed Maglev**

A new model must be created for this technology, because TYPESA's model is based on steel wheels on steel track, accounting for friction and other externalities.

A 7% grade capability was used. High-speed maglev can adapt much better to the I-70 corridor. There are about half the tunnels in this case, than in the previous case.

In many cases, this alignment runs parallel to I-70.

Shallow tunnels are risky, and can be more expensive than deep tunnels, sometimes. For the experts, shallow tunnels are any depth less than 300 feet.

This alignment could have a third and fourth bore for the Twin Tunnels.

One of the longest tunnels is located near Georgetown.

An alignment that can serve Keystone, Breckenridge and Copper Mountain has been developed. Traversing between Keystone and Frisco would be very difficult to do, but the alignment might be manipulated to support its development.

Whatever high-speed rail can do, maglev can do it as well. This alignment is about 20 miles longer than the high-speed rail alternative, but it hits many more potential station sites.

For both high-speed rail and maglev, the lines are elevated to reduce at grade alignments to increase speed and safety.

PLT Questions:

Q: What's the difference between acceleration and deceleration on maglev as opposed to high-speed rail? A: The Germans did a comparison between their HSR system and maglev. In HSR it took 13 miles, or 6m 20s, to build up to top speed, for maglev the time is 1m 30s to reach 185 mph.

For curvature, the comfort of the user is the limitation to the speeds that can be handled.

### **Medium Speed Maglev in I-70 ROW**

Stays in ROW, 1.5 miles of tunnels, 116.8 miles from Golden to Eagle County Regional Airport. Top speed is 120 mph but will be limited because of curves.

This alignment has the shortest amount of tunnels, and it basically runs along the median or on one side of I-70 or the other.

### **Medium Speed Hybrid Alignments**

Has 3 alternatives to allow serving potential station sites.

This alignment pretty much follows the I-70 ROW alignment with a few optimizations.

Design speed for these alignments is 100 mph, and in some cases 120 mph.

Eagle County Regional Airport is creating a master plan at the moment to account for a possible high-speed transit system endpoint.

PLT Questions:

Q: Is it correct to assume that the only technology that works along the alignment is the low speed maglev? A: No, the high-speed maglev can be run on low-speed alignment, it would just be a waste of speed.

Q: Does low-speed take more area than high-speed maglev? A: No, they take the same amount of space as one another.

Q: Is there a difference in cost between high-speed and low-speed maglev and high-speed rail? A: Yes, there's a difference. With HSR, energy consumption increases exponentially with speed. For maglev, that's not necessarily the case. In Spain it took 3 years to increase speed by 12 mph because of the increase in energy consumption.

### **Alignment Design Next Steps**

- Refine alignments based on feedback from technical committee.
- Develop speed profiles
- Environmental screening using PEIS data
- Finalize alignments (mid-April)
- Cost estimating
- Ridership modeling

#### **4. Station/Land Use Meetings**

Beth Vogelsang made presentation. The four counties are each having a workshop on station and land use. At these workshops, the concept is to run through alignment in that county, and possible stations locations are put in as they relate to these alignments.

Beth has been presenting the transit distribution network, environmental criteria, and developability options to the counties.

Two concept stations have been created, to represent different footprint sizes of possible stations. Larger transit interfaces will be needed in larger cities and towns, so there will need to be more land used for specific stations.

Beth stated that at this stage in the study we are looking at sites that are over 3 acres. At the county level, discussion needs to look at allowing for more acreage so that there can be development around the station locations. At this point in the study, the team is just trying to find sites that can accommodate station requirements.

#### **5. Maglev Performance**

Mike Riggs introduced Kevin Coates, who has been hired by AZTEC as a Maglev Specialist. At the last PLT meeting, a variety of questions were raised about maglev, so this portion of the presentation is a response to provide answers for those questions.

Kevin provided some basic maglev facts. He pointed out that various maglev systems are in different stages of development from conceptual to mature, deployed systems. He also said that the majority of maglev experience is outside US due to support from other governments for development. He then gave a brief history of maglev development.

Kevin then made presentation to answer the following questions:

#### **Q1: What assurance or proof do we have that a maglev system can operate on the grades in the I-70 corridor?**

Transrapid provided data on the ability of their system to climb grades. Kevin had Dr. John Harding, Retired FRA Chief Maglev Scientist verify the data. Kevin also presented a chart for the Japanese superconducting maglev showing its superior acceleration capability.

Kevin showed a short video of a low speed maglev in Japan climbing significant grades.

**Q2: Does snow and ice impact maglev operation?**

Kevin showed a video of a maglev operation with snow on the track that clearly showed the maglev blowing off the snow with no problem. He also provided information on how ice can be accommodated by maglev.

**Q3: Will large changes in temperature affect maglev operations (i.e. guideway expansion and contraction)?**

Testing in Japan and Germany have shown that maglev can operate in very cold and very hot conditions without any issues. For Transrapid, individual beams are separated allowing for expansion, contraction and adjustment of vertical and horizontal position.

**Q4: Is there conclusive evidence of maintenance being lower for maglev than conventional steel-wheel-on-steel rail and can we quantify the costs on a per mile basis?**

Kevin presented information showing that maintenance costs for maglev are much lower than conventional HSR, especially when HSR speeds increase. He shared emails from the operators of the Shanghai maglev that stated that in the last ten years, only two weeks of maintenance has been required.

Quantifying costs on a per mile basis is problematic as it will vary due to power needs related to speed. But Kevin indicated that operations and maintenance costs are half to 2/3 of costs for conventional HSR.

**Q5: What are pros/cons of so called smart track-dumb vehicles and dumb track-smart vehicles and what are implications regarding weight, grades, speed, need for overhead catenary, etc.?**

Kevin explained that since maglev systems are actually long electric motors, a more accurate way would be to describe these systems as “vehicle as rotor and tracks as stator” and “vehicle as stator and track as rotor”.

Problem with “vehicle as stator and track as rotor”, which is dumb track-smart vehicle, is that higher speeds require larger stators, increasing vehicle weight to the point where it is impractical to use.

“Vehicle as rotor and tracks as stator” systems are smart track-dumb car. It allows for higher speeds by keeping vehicle weight constant. This allows active guidance magnets to be used to control dynamic stability. It also allows use of onboard non-contact linear generators which eliminates frequent failure rate and high maintenance costs associated with power delivery costs.

**Q6: What are the steps needed to be able to receive some level of safety certification for a maglev system, how long will it take and who will lead?**

Kevin explained that when a Transrapid Maglev was proposed in Florida, FRA undertook to develop a rule of particular applicability governing the safety of that system and a significant amount of work was completed before the project was terminated.

Kevin also suggested that because FRA lacks any maglev scientists, FRA could hire new experts from abroad or accept a foreign governments certifications for passenger service.

**PLT Questions:**

Q: What kind of sidewind can this technology handle? A: The Germans have tested and approved 80 mph sidewinds. This information is provided in the documentation Kevin has.

Q: Is the Chinese system really a reverse engineering of the German system? A: The Germans advised the Chinese on the construction of the guideway. The Chinese chose to design their own guideways, even though the Germans provided the switches. The Chinese dig their columns for the high-speed maglev 70 meters deep sometimes.

Q: Do you think the Chinese are looking to turn this into an export style international business? A: There may be that incentive later down the road, even on this project, there may be a Chinese representative who helps. The maglev community is frustrated with the Chinese who have not released their knowledge and information on this technology.

6. Funding/Financing Workgroup

Pamela Bailey-Campbell of Jacobs provided an update.

Information is synchronized with the ICS Team, so that both the studies aren't conducting the same studies twice. Based on preliminary conversations, it will be important to finish work on task force and funding information including feedback from ridership studies being conducted and refined according to alignment configurations.

Key question to be answered by workgroup is what constitutes financial feasibility?

If this project is going to be put in place, funding sources will need to be sufficient enough to pay to fund the projects over time.

Farebox should be sufficient to cover operations and maintenance costs, this is the assumption today.

There are construction costs and total project costs. Construction costs are verifiable in the \$30-\$40 million range. Total project cost is about 1.8x that value for ROW acquisition, engineering, and environmental compliance issues. These are things that increase the cost of development. Total project costs are likely to be \$100 million/mile for all technologies. Building high-speed rail in the US is more expensive than anywhere else in the world, more than China and Germany.

Mike indicated that the AGS team is thoroughly examining all of the cost information that's been provided by the technology providers to make sure that it's reasonable. The providers say what they believe each mile of installation to cost, but there are outside factors that accumulate and create additional needs for more funds per mile of development.

Mike also stated that what we don't want to do is lowball the cost estimates. It makes all of us look bad when it comes down to it.

David Krutsinger pointed out two issues to deal with: The big cost benefit, what are the benefits from spin off revenues. Can the system provide enough economic benefit to the corridor and

state? And, what revenue do you have to pay back the loan you've taken out? Can the mortgage on the system be paid?

CDOT - DTR is still trying to figure out how to pay for the mortgage portion of the project first. A lot of the monetary issues at this point in time have less to do with financing, and more to do with revenue streams.

The PLT was asked what kind of interaction or information does the PLT need to know they're accomplishing at Funding and Financing Workgroup meetings? The PLT responded that they would like to be invited into funding and financing conversations, so that they can tell their constituents what is going on with these monetary issues. The PLT wants a roster for who's in the group, and a list for when meetings are held, and if a PLT member wants to sit in on the meetings, they should be able to do so with ease. When the meetings happen, Mike Riggs will send out an e-mail to the PLT to inform members, and offer the opportunity to address the previous two bullets.

Funding or implementation for the AGS is needed by 2025, which means funding needs to be established by 2018.

Connection to DIA is important, because funding may not be available for the AGS unless there's a multi-modal connection to DIA.

#### **PLT Questions:**

Q: Are you doing the cost for the whole system (Golden - Eagle County Airport)? A: We're doing cost by segment, because our minimum operating segment is somewhere west of metro area to somewhere west of Continental Divide, then a cost from there to ECRA.

Q: What governance ownership model is assumed at this point? A: There is none. At the end of the day the infrastructure is owned by the public sector, has been assumed. It's owned, but not necessarily operated by a governmental entity. If we're going to have a fund that deals largely with tax dollars, then someone will have to ensure that the spending is appropriate through proper oversight.

Q: What's a reasonable assumption for federal funding? A: The F&F folks are just assuming that the federal government can provide anywhere between 0% - 50% of the funding.

Q: What kind of federal funding source, who are you competing against? What other CDOT or state transit projects is AGS competing against? A: New Starts funding for FTA for whole country in 2013 is \$1.9 billion. Trying to get 25% of the CO HSR funds, will take a large portion of funds away from other transit projects around the country.

Q: Is ICS doing financial study as well? A: AGS has to deal with this issue in a different manner, because at the end of this study a conclusion must be met, ICS only has to conduct a study. ICS provides a range of revenue options, costs, and phasing plans. AGS needs to say yes the system is technologically and financially feasible by 2025 or it is not.

Q: An election to increase revenue to AGS, and other entities increasing revenue for their projects, where's the viability for this project to receive 'yes' votes on funding? Is this a good idea? A: Part of the reason why we're having this discussion is to figure this out. Should the State wait to propose a sales tax increase to fund multiple transportation projects? This issue



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needs to be discussed from a qualitative standpoint.

#### 7. AGS/ICS/Co-Development Project Coordination

Mike Riggs gave an update on the ICS project. He stated:

- PLT Meeting #4 was held February 26
- Team is developing initial model runs for each RMRA pairs
- Capital cost estimating is complete
- Draft services plans are being finished
- Team is ready to launch model runs for ICS scenarios

RFP for the Traffic and Revenue (T&R) Study has been issued. Proposals are due April 5. On March 21, 2013, CDOT is having a Traffic and Revenue 101 session, so that everyone can understand what the study is and isn't, and what the expected outcomes are.

#### 8. Conclusion, Final Remarks & Next Steps

Next PLT Meeting will be April 10, 2013 at Jefferson County Courts and Administration Building. Topics to be determined.