Speaker on Why Space Exploration, and Moon, and Mars?

Joseph A. Brown

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Saturday Morning Panel Paper

“Why Space Exploration and Moon and Mars”

Joe Brown
Why Space Exploration, and Moon, and Mars?
Diversified Energy Independence “DEI”

Why Are We Going to the Moon?
A Cost Engineer’s Two Dreams Scenario

Space Exploration Estimating Tools, Facilities, GSE, and Cost Engineering

Why Space Exploration and New Estimating Tools? - For Budgeting Facilities and GSE for Launch Vehicles

By Joseph A. Brown,
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Abstract/Introduction

Thirty-two (32) reasons - twelve (12) general, sixteen (16) specific, and four (4) money makers. To help USA balance the budget, balance the trade deficit, bring back a strong U.S. dollar, and a stronger U.S. capitalist society. Two new 2 trillion dollar industries to provide clean electrical power, eliminate oil and natural gas imports, and provide for money making exports. However, there are many challenges to be solved before this can happen. What are the 15 specific reasons? What are the challenges? How can this happen? Where can these new, clean energy power plants be built? Where can these new power plants or energy receiver net antennas be built? What are the other general reasons for going to the Moon and Mars? What are two solutions for energy independence (EI)? What are some other money makers? What are the thirty (30) newest, of the over 300 tools, being used to budget and design the Kennedy facilities and GSE projects for the Moon, Mars $300 billion dollar Constellation Program?

Background

Back to the Moon Lessons Learned and Futuristic Comment -

Back to the Moon Lessons Learned. When as a team we all signed the steel beam for the VAB structural roof framing, we bonded together with Gods help for success in meeting the “Big Challenge” movie, video, and soon to be DVD by CCTS or CCCI. Some comments and thoughts from the Nov. 27, 2003, report by Cost Engineer, Space Pioneer, Advocate, Cost Data Historian JAB: several of JAB books, such as JAB Volume 13 “Aerospace Activation Price Book, Oct. 1, 2002, tool #11” was also dedicated in memory of three space mishaps and shuttle astronauts of Apollo 13, February 13, 1970 - Shuttle Challenger - January 28, 1986, and STS 107, Columbia was launched January 15 at 10:30 a.m., 2003, and had mishap upon reentry. In three major space mishaps, no one on earth was hurt from manned space launch vehicle falling debris. Columbia had over 50,000 pieces from gram size to hundreds of pounds fall from California to Louisiana. No damage from debris from Apollo 13 or from Challenger, which mostly fell in Atlantic Ocean in restricted zone. None of this falling debris has yet to hurt anyone on earth. Had this debris fallen and injured hundreds or thousands of people on earth, it may have been the end of our space program. However, JAB believes this is God’s way of telling us to continue space explorations, as for example, going back to the moon, some reasons; and some potential money makers.

41st Space Congress April 26-30, 2004 – Technical presentation at Cape Canaveral, Florida, on China, Moon, and Mars confirms USA goals and plans. Remember – we were able to pray Apollo 13 astronauts back to earth with God’s help. Let us keep vigilant (on the lookout) so we can have the time and public support to pray them home again, when and if we have another space mishap. In the mean time we need to go back to the moon for
continued space exploration and then on to Mars. The 1994 Space Congress had another outstanding presentation by W.M. Braselton on “Space Power for an Expanded Vision,” a great video by Harris Corporation, which explains use for energy and as a fuel for Mars exploration. We hope to convert this information to CD/DVD this year.

**Facilities & Ground Support Equipment, GSE**

Some KSC facilities are LS-39 Launch Area including: VAB, LCC, OPF’s, two launch pads, support buildings, crawler transporters, three launch platforms “MLP’s,” crawl-away, park sites, SSPF, O&C, RPSF, VPF, LETF, GSE (items used to transport, access, handle, protect, service, and check-out flight hardware/software on the ground) such as: RSS, platforms, panels, ECS Systems, cranes, hoists, lifting devices, and auto couplers. See JAB Website [www.lobiddervideo.com](http://www.lobiddervideo.com), Estimating Tools for pictures of GSE and facilities, also see JAB Vols. 14 and 15, pgs. 18-26, and 96-99. Also see website Searchable Vol. 18.

**Some Specific Reasons for Space Exploration to the Moon and Mars**

1. Moon Port #2 - Launch Base for future space exploration and to Mars
2. Moon - permanent, scientific, technical Hubbell
3. Sciences - studying of the earth, the moon, and living in space
4. Medical – examples: moon may be best for future heart and head surgeries; and healing
5. Defense - look out post on moon
6. Tourism - $50,000- $5 million moon visit or vacation. Some have paid $20 million for a trip just to the International Space Station (possible money maker)
7. Moon base to launch space vehicle to prevent asteroids from striking earth.
8. A better place to launch space systems to temporarily shield earth’s critical communication satellites from solar/magnetic space radiation caused by solar flames which have caused major communication blackouts.
9. If our human future existence on earth is in jeopardy, moon living is a possible option (such as Noah’s Ark)
10. International teamwork for future world peace.
11. To keep our claim to moon resources, especially, now that China is also going to the moon for
12. Moon mining of other critical resources
13. Surprises - like USA Industrial Revolution, satellites, space program, electrical/electronics, communications and nuclear, etc.
14. Moon Mining of Helium 3, a new clean energy source. The moon has thousands of years’ supply, a shuttle load of Helium 3 can power the United States electrically for one year, (money maker)
15. Solar, electrical energy from space satellites using external tanks with solar cells (another possible money maker and energy independence) - Solar satellites are 3-20 times more efficient than on earth, because of 24/7 operations and less earth environmental restrictions and little or no battery backups are required. Can be beamed to the earth where needed and may also provide reflective sunlight to light up cities at night.
16. Commercial advertising from the Moon. Examples: testing moon buggies, ATV’s, automobiles, beverages, food, durable products, etc.

**Some Challenges to the Moon and Mars Project**

**Scenario I - Moon Mining of Helium 3**

**General Comments:**

- Peer review comment: more references needed
- One shuttle load of Helium 3 can power the US electrically for one year.
- Helium 3 is a clean energy source
- Over 1000 years of Helium 3 on the moon.
- Helium 3 can be a power source for Mars and other space explorations.
- In 2004 my associate seminar was skeptical about Helium 3, as we were discussing moon mining of Helium 3. He turned to his computer and goggle searched Moon Mining Helium 3, to our surprise and amazement Google showed over 1,125,000 thousand hits, (present search of Helium 3 as of today, 3/13/07, is 7,140,000). Therefore, we will list that in our references. Hits for Moon Mining of Helium 3 is 270,000.
Challenges Moon Mining of Helium 3

1. $100/lb payload to the moon.
2. $500/lb earth to moon and return payload if necessary
3. Three (3) launch pads to provide 10-20 day return flights. To return Helium 3 rods from the moon for earth power generation. See Ref #’s 3, 4, 5, 7
4. New higher level of reactor to start for earth bound Helium 3 rods for power plants. - We are looking for more answers from the engineering and scientific community.
5. US economy deficit, trade and budget deficits to be corrected.
6. Education of American people regarding disciplined saving and spending, improved productivity, and solving the high cost of medical insurance and taxes and Accelerated Space Exploration Program.
7. Protecting Helium 3 from earth’s magnetic field or beaming the electrical energy from the Moon to U.S. or other countries. Note: We have communicated with astronauts on the moon sending and receiving television therefore it may be another small step to sending Helium 3 electrical power from the Moon as another clean energy source.
8. Funding, government funding, and/or commercial funding.
9. A new challenge for our engineers and scientists would be beaming the electrical power from the moon to the earth via satellites and/or Space Station or the solar power satellites by Space Island Group.

See references: University of Wisconsin 1990’s Study Report on Moon Mining of Helium3 from the KSC library

Peer Review Question

How does the reader know that the Helium 3 operation will not result in environmental radioactivity? Answer: See University of Wisconsin Study Report regarding Helium 3 as a clean energy source; and video on Expanded Space Exploration.
Helium 3 can be used as a fuel to power space vehicles to Mars, similar to present technology using uranium to power space vehicles.


(Pictures are being used with written permission from Harris Corporation)
Scenario II: Solar Electrical Energy from Space Satellites

World wild wholesale electrical sales now $2 trillion dollars per year, by 2050 will grow to $10 trillion dollars. NASA spin-off solar power from space proposed 30 to 40 years ago, could deliver clean, electrical energy, 24/7, to earth. A joint proposal from Space Island Group (SIG) and NASA for Asian countries could reduce launch cost by using the external tanks in space for solar, electrical power generation space satellites, and provide a boost to U.S., KSC with 50 to 100 extra big launches per years to put this system in space. (Reference Space Vision Congress Technical Paper by Gene Meyers, “Eliminating the Prohibitive Launch Cost of Solar Power Satellite.”)

What are the Challenges for Space Solar Power Satellites?

Funding - may be solved soon
Cost Control/Cost Engineering - Critical in R&D and space projects where outside funding is required.
Safety - Too many launches may cause launch and space safety hazards which need to be addressed as we have never launched space vehicles successfully as often as may be required for the cost benefits of this program.
Coordination - NASA, DOD, range, and commercial is critical for the successful space launch facilities and launch rate (per NASA/KSC retiree, DE Facilities Manager and JAB, 2/21/07).

ADDITIONAL CHALLENGES FOR SCENARIO I AND II:

Where could these power plants or electrical net antennas be built?

1. At KSC (8800 acres) in the new research area and/or adjacent to the propose polygeneration power plant, which has be sited.
2. At Vandenberg AFB as prototypes and to solve the “not in my backyard” NIMBY issue.
Some General Reasons for Space, Moon, and Mars Exploration

1. US economy
2. New Industries
3. World Economy
4. Environmental - global warming
5. Curing the US/World trade deficit problem for agricultural industry - moon soil grows better
6. For research and development programs, develop more technologies, industries, and businesses
7. Science/Physics - living and working on another planet at ½ lunar gravity.
8. Political reasons - strengthen our influence, status, and teamwork
9. Medical industry - new processes and medicines, such as arthritis and diabetes advances
10. International Teamwork
11. Because the American and world people would want us to go back to the moon when they realize the great cost benefits for mankind.
12. EI - Energy Independence

What are the Newest, Most Exciting, and Important of the 300 Cost Engineering Tools?

These are necessary for budgeting and cost control of the KSC and GSE requirements for launch facilities.

1. Over 300 KSC Cost Indexes provide experience and back up, early cost alert for construction, and GSE Cost Escalation, latest dated December 30, 2006 (one of the most important tools)
3. Near 500 systems summaries, facilities, GSE, processing, pads, over fifty different type of projects
4. 21 Computer Templates, Budgets, Design, Preliminary and Detailed Estimates, etc.
6. Estimating Fiber Optics Cable Method, fast and easy
7. Remote Automated Panels, Man-hours, Method, fast and easy, $10,000-$300,000
8. Cost per component, fast and easy, $1,000-$2,500
9. Fine tuning, number of bidders concept, bid strategy
10. Construction Management Analysis Method
11. Cost Index Analysis Matrix for design, productivity, etc.
12. Cost Escalation Alert Analysis, four new technical papers
13. Launch Pad Cost Comparisons, $20 million to $300 million dollars
14. Detailed Launch Pad Cost Breakdown, $1.2 billion dollars
15. VAB Cost Studies, $160 million to $2 billion dollars
16. “Accurate Estimates in a Minute,” by NASA/KSC Glenn Butts (one newest, most important tools)
17. Searchable CD-ROM by Dallas Lee/SGS
18. Abstract of Bids, Cost Summaries, System Summaries, hyperlinked
20. Searchable CD-ROM’s of System Summaries with Excel Search
21. Near 30 Special, Unique Cost Studies, Change Orders, COC, Mark-Ups, O, H& P, etc.
22. JAB PowerPoint, “How to Make System Summaries”
23. JAB PowerPoint, “Aerospace Cost Factors,” 8 different seminars lasting from 3-40 hours, 49 successful seminars
24. 9 Different Seminars lasting from 3 to 40 hours
25. DVD on Bidding Strategy on Aerospace and Construction
26. New CD-ROM’s, #18, 19, 20, 21, and #25
27. “Space Power for an Expanded Vision” by W.M. Braselton, 15 minute video, DVD soon
28. New Multi page system summary/cost model of the $150 million dollar VAB
29. NASA/KSC CD-ROM Apollo, Space Shuttle, ISS, Cost Data, History by Glenn Butts, 2006
30. 475 Projects, Cost Estimate, over 45,000 pages (microfilm)
31. JAB Seminar #9, Bidding Process and Cost Engineering, Vol. 20
32. Glen Butts Cost Engineering Desk Reference 2006
Some Answers to the U.S. Economy and High Construction Cost Escalation

The Moon/Mars program could help solve: falling U.S. dollar; U.S. growing trade deficit; growing budget and spending, local and world wide global warming, and growing pollution problems.

Some Solutions

Education of the American public on these problems and possible solutions

- Continuing productivity improvement, such as computerization has helped since the 1970’s and future CAD/cost engineering 5D. (cost estimating, scheduling, cost control).
- Developing a new 2 trillion dollar industry that is pollution and radiation free that the US has most (nuclear) experience in, such as the moon mining of Helium 3.
- US to build 100 - 1000 megawatt power plant, 15 billion each, QROME (Quick, Rough, Order of Magnitude Estimate) and exporting to the world 1100 - 1000 Megawatt Power Plants, 15-25 billion each, and selling them at a profit. 1 to 20 moon flights per year at $1-2 billion dollars each to bring back Helium 3 (5,000-50,000 lbs/flight). Also new tourist industry, vacations, and honeymoons, and medical surgery and recovery, and advertising from the moon.
- Worldwide use of Helium 3 can be an economic boost to the US and world wide economy, improving the US trade/budget deficits. Also diversified energy independence “DEI”. One shuttle (65,000 lbs) load of Helium 3 can power the US electrically for one year.

Additional reading references for the top world power plants can be seen at: http://www.industcards.com/top-100-pt-1.htm

Incorporation of Comments from Peer Review and General Comments

1. This updated paper has incorporated peer review comments for clarification, important background information, and additional references.
2. In 1955, JAB stationed in Germany was taking a photography workshop by a very good German teacher. An important comment was made concerning European and world pollution, “It’s better to take pictures after a good rain as it cleans the air of pollution and gives a sharper image, in black and white and color.” It would appear this is also true in many major industrial US cities, as well as other world-wide metropolitan areas. Therefore, the clean energy sources from Helium 3, solar, and wind are critical for a healthier environment and human existence.
3. Diversified energy independence such as solar power satellites, moon mining of Helium-3, clean coal energy and wind are important to save our oil and gas industries for automobiles, plastics, etc. Also to reduce oil monopolies - the US is presently using coal for fifty percent of our electrical energy.
4. Why so many titles? Because it will vary with the different audiences, and it is hoped this may be presented many times in many places as an educational effort to alert the American people.

Comments: Peer review was “inspiring, and we need some inspiration now with the global warming, a threatening energy crisis and that national debt we don't want to talk about.

What should be used for high cost escalation for the NASA KSC Space Program to the Moon & Mars Facilities and GSE? Consider using 5% to 10% per year, but on major multi-year projects that are heavy weighted in concrete, steel, rebar, copper, asphalt, and aluminum do a cost analysis, or get quotes on major cost items. Remember that impact, scheduling delays, and change order will cost extra for time extensions. Escalation may last for several more years, but now there is some hope for relief. February 2007 international stock market melt-down may cause more time needed to evaluate the effects on world trade and commodities, etc. An analysis update will be required.

Summary

In summary, we must continue educating the American people on the importance to the US economy, world pollution, productivity, cost engineering, and an accelerated space program for the continued success of our country.
References, Suggested Reading, Viewings and Web Viewing


7. “Space Power for Expanded Vision,” 15 minute video by Harris, Bechtel, and University of Wisconsin


9. “How Does the Low Bidder Get Low and Make Money?” video by JAB, CCCI, and Communications Concepts Inc. (CCI)


17. University of Wisconsin 1990’s Study Report on Moon Mining of Helium 3 from the KSC library


19. Google Web search for Moon Mining Helium 3, [www.google.com](http://www.google.com)


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jkendrick, Why Moon/Mars, 3/18/2007
Brief Bio

Joseph A. Brown,
CCE, President CCCI

1962 to Present
Construction Cost Consultant, CCE President. Consultant services, writing, training, educational seminars, cost engineering, cost estimating, preparing, reviewing, cost analysis of over $10 billion of cost estimates for facilities, construction, GSE, activation, etc. With over 300 Aerospace cost engineering tools, books, CD ROM’s, DVD’s, videos, cost studies and new exciting, conceptual estimating methods. Over 2000 seminars students from six continents. Space Works Engineering Inc. (SEI) FGOA/D4OPS contract, July 19, 2003 thru Jan. 15, 2004 with near $4 billion of conceptual cost estimates and analysis.

Joseph A. Brown created a world class total Aerospace Cost Estimating, Cost Engineering, CM for Facilities, Construction, GSE system and activation. This system and process has proven performance and results, saving billions of dollars with nearly 300 unique tools, including over 30 new, exciting tools, technical papers, and cost studies for space exploration to the Moon, Mars, and the Universe. This world class cost engineering system was created from five tools in 1963 by JAB and his KSC teamwork effort.

July 1, 1996 – October 28, 2005. Lockheed Martin/USA Space Flight Operations Contract (SFOC) as Senior Engineer, Certified Cost Engineering, Cost Consultant for facilities and ground support equipment (GSE) and construction, preparing, reviewing, cost analysis, (over $10 billion of cost estimates), modification management, training, seminars, and computerization. These important estimating tools:

- Helped reduce change order (C.O) cost from 52% to 12.50% of bid cost with 150 ways to reduce C.O. cost on over $300,000,000 of Construction and GSE
- Helped improve design performance, cost and schedule performance with large bonuses to KSC team work members through cost engineering, construction management, cost control, planning and scheduling, cost analysis, computerization, and incentive contract, etc.

- Aided NASA/KSC Designing Engineering in restart of cost engineering presence, providing consulting services, resources, etc.


1963 – 1955. (GS11/14) National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC), Lead Cost Engineer, Senior Advisor and Coordinator for development of cost engineering and estimating for KSC facilities, equipment, and construction. Prepared and reviewed over $17 billion of cost estimates, including pre-conceptual space shuttle launch facilities at six locations, Oct. 1970 for $7.44 billion, EELV $5.9 billion and LC39 VAB and Launch Pad over $200 million, 1963-1970. See the website for detailed resume (www.lobidderviedo.com) or contact me at lobiddervideo@cfl.rr.com

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Diversified Energy Independence “DEI”

Why Are We Going to the Moon?

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Space Exploration Estimating Tools, Facilities, GSE, and Cost Engineering

Why Space Exploration and New Estimating Tools? - For Budgeting Facilities and GSE for Launch Vehicles

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U.S. Government Publication such as NASA not subject to Copyright
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32 Reasons – 12 general, 16 specific, 4 money makers
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  – bring back a strong U.S. dollar, and a stronger U.S. capitalist society.

Two new 2 trillion dollar industries to
  – provide clean electrical power,
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  – and provide for money making exports.

However, many challenges need to be solved before this can happen.
  • What are the 15 specific reasons?
  • What are the challenges?
  • How can this happen?
  • Where can these new, clean energy power plants be built?
  • Where can these new power plants or energy receiver net antennas be built?
  • What are the other general reasons for going to the Moon and Mars?
  • What are two solutions for energy independence (EI)?
  • What are some other money makers?
  • What are the thirty (30) newest, of the over 300 tools, being used to budget and design the Kennedy facilities and GSE projects for the Moon, Mars $300 billion dollar Constellation Program?
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Project Orion Overview And Prime Contractor Announcement

Skip Hatfield
Orion CEV Project Manager

August 31, 2006
Orion Advances the Human Exploration Vision

- Orion is the next generation crew piloted spacecraft
  - Human access to Low Earth Orbit …
  - … and to the Moon and Mars

- Orion has a talented management team and workforce which utilizes unique personnel and facility strengths from across NASA and industry

Orion to meet the mission
- Finalize requirements
- Mature the technology
- Design the Systems
- Test the Systems
- Prepare for first flight operations

- We are committed to meeting the national priorities for Orion!
Lunar Mission
Capable of Space Station Missions
Orion Crew Module
Orion Launch Abort System

- Attitude Control Motor
- Jettison Motor
- Abort Motor
- Boost Protective Cover
Lunar Mission
Orion Service Module
Shuttle Derived Launch Vehicle Concepts

William J. Rothschild and Debra A. Bailey (Boeing, NASA Systems),
Edward M. Henderson (NASA/JSC), and Chris
Crumbly (NASA/MSFC)

For Presentation at the AIAA Joint Propulsion Conference

Tucson, Arizona July 10 - 13, 2005
Figure 5. The in-line medium-lift SDLV option uses mature, human-rated propulsion elements for a high-reliability CEV launcher.
Figure 8. The in-line heavy-lift SDLV option offers massive payload capabilities built on mature propulsion elements.
Facilities & Ground Support Equipment, GSE

Some KSC facilities are LS-39 Launch Area including:

- VAB,
- LCC,
- OPF’s,
- two launch pads,
- support buildings,
- crawler transporters,
- three launch platforms “MLP’s,”
- crawl-away,
- park sites,
- SSPF, O&C, RPSF, VPF, LETF, GSE
- Items used to transport, access, handle, protect, service, and check-out flight hardware/software on the ground such as:
  - RSS, platforms, panels, ECS Systems, cranes, hoists, lifting devices, and auto couplers.

See JAB Website www.lobiddervideo.com, Estimating Tools for pictures of GSE and facilities, also see JAB Vols. 14 and 15, pgs. 18-26, and 96-99. Also see website Searchable Vol. 18.
Pads ‘A’ & ‘B’ and Proposed Pad ‘C’ – Background LC-39 Overview
Significant KSC Cost Drivers

- Electrical - Special Lightning Protection
  Emergency Power
  Uninterruptible Power

- Acid Disposition
  Epoxy
  Polyurethane Coating

- High pressure Panels, Vacuum jacket, Hypergolic / Cryogenic, Cranes, Brakes, and Controls
  Electrical - Bonding and Grounding

- Sound Suppression for Solid Boosters

- PCR - Clean Rooms

- GN2 - Explosion Proof

- Special underground utility tunnels for Hi-pressure piping & cable trays

- Weather Extremes
  Hot to freezing (requires extra insulation and protection)
VAB Interior Concept Illustration
Suspended Concrete Slab Forming – 520 Feet
Orbiter Processing Facility

- Orbiter Processing Facility – Phase 1
- Way #67 Special sub-contractor team work – (a “closed shop” team work effort helped them win this bid). Project Manager for Briscoe later confirmed this was a money maker for them (see system summary)
Artist Rendering – SSPF Space Station Processing Facility, also for Constellation
• **Ground Support Equipment (GSE)**
  – Items or units used to transport, access, handle, protect, service, or checkout flight hardware/software on the ground

• **Ground Support Equipment Item Description (GSEID)**
  – The GSEID defines and describes the physical and functional characteristics of the system / subsystem / equipment to be design, developed, procured, fabricated / assembled, tested, checkout and used
  – All interfaces with other systems and equipment, flight and ground, are identified
  – Performance requirements are included and verification testing identified

• **KSC SPEC G-0003 July 5, 1977**
  – Further GSE function designations (TR 1287)
    • Servicing
    • Checkout & Test
    • Handling & Transportation
    • Auxiliary
    • Uncategorized
Examples of GSE: CCS

- Computer Control Systems (CLCS),
- Hardware: Computer processing unit, printers, display monitors storage devices
- Software: Programs – “People Soft”, “Magnum”, KIMS
- Training: Video Instruction
- Electronic / Electrical: Cabling, Control, Sensors, Racks, Solenoids, Motors, Power, Communication, Instrumentation, and Video Cameras
Examples of GSE: ECS

- Environmental Control Systems, Portable ECS Units
- HEPA Filters, Clean Room
- Equipment Pumps, Compressors
- SS Double Wall Ducts, and ECLSS
Example of GSE: Panels

- GHe, GN2, and Breathing Air
Examples of GSE: Piping

- Vacuum Jacket, High pressure, Tubing, Flexible hoses, and Double wall stainless
Examples of GSE: Architectural

- Environmental Enclosure on end of Swing Arm Canisters
Examples of GSE: Machinery

- Rotating Swing Arms, Cranes Hoist, Lifting Devices and Transporters
Examples of GSE: Structural – KSC Shuttle GSE

- OPF, VAB PCR / RSS, FST Aft Platforms, and Orbiter Access Platforms
Some Specific Reasons for Space Exploration to the Moon and Mars

1. Moon Port #2 - Launch Base for future space exploration and to Mars
2. Moon - permanent, scientific, technical Hubbell
3. Sciences - studying of the earth, the moon, and living in space
4. Medical – examples: moon may be best for future heart and head surgeries; and healing
5. Defense - look out post on moon
6. Tourism - $50,000- $5 million moon visit or vacation. Some have paid $20 million for a trip just to the International Space Station (possible money maker)
7. Moon base to launch space vehicle to prevent asteroids from striking earth.
8. A better place to launch space systems to temporarily shield earth’s critical communication satellites from solar/magnetic space radiation caused by solar flames which have caused major communication blackouts.
9. If our human future existence on earth is in jeopardy, moon living is a possible option (such as Noah’s Ark)
Some Specific Reasons for Space Exploration to the Moon and Mars

10. International teamwork for future world peace.

11. To keep our claim to moon resources, especially, now that China is also going to the moon for Moon mining of other critical resource

12. Surprises - like USA Industrial Revolution, satellites, space program, electrical/electronics, communications and nuclear, etc.

13. Moon Mining of Helium 3, a new clean energy source. The moon has thousands of years’ supply, a shuttle load of Helium 3 can power the United States electrically for one year, (money maker)

14. Solar, electrical energy from space satellites using external tanks with solar cells (another possible money maker and energy independence) - Solar satellites are 3-20 times more efficient than on earth, because of 24/7 operations and less earth environmental restrictions and little or no battery backups are required. Can be beamed to the earth where needed and may also provide reflective sunlight to light up cities at night

15. Commercial advertising from the Moon. Examples: testing moon buggies, ATV’s, automobiles, beverages, food, durable products, etc.
Some Challenges to the Moon and Mars Project

SENARIO 1 – MOON MINING OF HELIUM 3, GENERAL COMMENTS:

1. One shuttle load of Helium 3 can power the US electrically for one year.
2. Helium 3 is a clean energy source
3. Over 1000 years of Helium 3 on the moon.
4. Helium 3 can be a power source for Mars and other space explorations.
5. In 2004 my associate seminar was skeptical about Helium 3, as we were discussing moon mining of Helium 3. He turned to his computer and goggle searched Moon Mining Helium 3, to our surprise and amazement Google showed over 1,125,000 thousand hits, (present search of Helium 3 as of today, 3/13/07, is 7,140,000).
6. Hits for Moon Mining of Helium is 270,000
Challenges Moon Mining of Helium 3

1. $100/lb payload to the moon
2. $500/lb earth to moon and return payload if necessary
3. Three (3) launch pads to provide 10-20 day return flights. To return Helium 3 rods from the moon for earth power generation. See Ref #’s 3, 4, 5, 7
4. New higher level of reactor to start for earth bound Helium 3 rods for power plants. - We are looking for more answers from the engineering and scientific community.
5. US economy deficit, trade and budget deficits to be corrected.
6. Education of American people regarding disciplined saving and spending, improved productivity, and solving the high cost of medical insurance and taxes and Accelerated Space Exploration Program.
7. Protecting Helium 3 from earth’s magnetic field or beaming the electrical energy from the Moon to U.S. or other countries. Note: We have communicated with astronauts on the moon sending and receiving television therefore it may be another small step to sending Helium 3 electrical power from the Moon as another clean energy source.
8. Funding, government funding, and/or commercial funding.
9. A new challenge for our engineers and scientists would be beaming the electrical power from the moon to the earth via satellites and/or Space Station or the solar power satellites by Space Island Group.

See references: University of Wisconsin 1990’s Study Report on Moon Mining of Helium3 from the KSC library
Moon Base Mining of Helium 3 – New Industry – Clean Energy Source -
$^3$He Fusion is One of the Cleanest Nuclear Reactions

Deuterons ($^2$H) + Helium-3 ($^3$He) → Proton ($^1$H) + Helium nucleus

Fusion Reaction
Scenario II: Solar Electrical Energy from Space Satellites

World wild wholesale electrical sales now $2 trillion dollars per year, by 2050 will grow to $10 trillion dollars. NASA spin-off solar power from space proposed 30 to 40 years ago, could deliver clean, electrical energy, 24/7, to earth.

A joint proposal from Space Island Group (SIG) and NASA for Asian countries could reduce launch cost by using the external tanks in space for solar, electrical power generation space satellites, and provide a boost to U.S., KSC with 50 to 100 extra big launches per years to put this system in space.

What are the Challenges for Space Solar Power Satellites?

• **Funding** - may be solved soon

• **Cost Control/Cost Engineering** - Critical in R&D and space projects where outside funding is required

• **Safety** - Too many launches may cause launch and space safety hazards which need to be addressed as we have never launched space vehicles successfully as often as may be required for the cost benefits of this program

• **Coordination** - NASA, DOD, range, and commercial is critical for the successful space launch facilities and launch rate (per NASA/KSC retiree, DE Facilities Manager and JAB, 2/21/07)
12 Ring Center
Detailed of Solar Panel

Why Space Exploration to Moon and Mars?

Page 55
Some General Reasons for Space, Moon, and Mars Exploration

1. US economy
2. New Industries
3. World Economy
4. Environmental - global warming
5. Curing the US/World trade deficit problem for agricultural industry - moon soil grows better
6. For research and development programs, develop more technologies, industries, and businesses
7. Science/Physics - living and working on another planet at ½ lunar gravity.
8. Political reasons - strengthen our influence, status, and teamwork
9. Medical industry - new processes and medicines, such as arthritis and diabetes advances
10. International Teamwork
11. Because the American and world people would want us to go back to the moon when they realize the great cost benefits for mankind.
12. EI - Energy Independence
Newest, Most Exciting, and Important of the 300 Cost Engineering Tools

1. These are necessary for budgeting and cost control of the KSC and GSE requirements for launch facilities.
2. Over 300 KSC Cost Indexes provide experience and back up, early cost alert for construction, and GSE Cost Escalation, latest dated December 30, 2006 (one of the most important tools)
4. Near 500 systems summaries, facilities, GSE, processing, pads, over fifty different type of projects
5. 21 Computer Templates, Budgets, Design, Preliminary and Detailed Estimates, etc.
7. Estimating Fiber Optics Cable Method, fast and easy
8. Remote Automated Panels, Man-hours, Method, fast and easy, $10,000-$300,000
9. Cost per component, fast and easy, $1,000-$2,500
10. Fine tuning, number of bidders concept, bid strategy
11. Construction Management Analysis Method
12. Cost Index Analysis for design, productivity, etc.
13. Cost Escalation Alert Analysis, four new technical papers
14. Launch Pad Cost Comparisons, $20 million to $300 million dollars
15. Detailed Launch Pad Cost Breakdown, $1.2 billion dollars
16. VAB Cost Studies, $160 million to $2 billion dollars
Newest, Most Exciting, and Important of the 300 Cost Engineering Tools

17. “Accurate Estimates in a Minute,” by NASA/KSC Glenn Butts (one newest, most important tools)
18. Searchable CD-ROM by Dallas Lee/SGS
19. Abstract of Bids, Cost Summaries, System Summaries, hyperlinked
20. JAB Vol. 18 Searchable 254 Tools and Prices, sources, 25 book indexes, 20 CD-ROM’s, see www.lobiddervideo.com
21. Searchable CD-ROM’s of System Summaries with Excel Search
22. Near 30 Special, Unique Cost Studies, Change Orders, COC, Mark-Ups, O, H& P, etc.
17. JAB PowerPoint, “How to Make System Summaries”
18. JAB PowerPoint, “Aerospace Cost Factors,” 8 different seminars lasting from 3-40 hours, 49 successful seminars
19. 9 Different Seminars lasting from 3 to 40 hours
20. DVD on Bidding Strategy on Aerospace and Construction
21. New CD-ROM’s, #18, 19, 20, 21, and #25
22. “Space Power for an Expanded Vision” by W.M. Braselton, 15 minute video, DVD soon
23. New Multi page system summary/cost model of the $150 million dollar VAB
25. 475 Projects, Cost Estimate, over 45,000 pages (microfilm)
26. JAB Seminar #9, Bidding Process and Cost Engineering, Vol. 20
27. Glen Butts Cost Engineering Desk Reference 2006
Cost Estimating Tools Used in the Past
15 New Exciting Estimating Tools Spin-offs

- Cost per Panel Component Chart – Labor, Material & Fabrication – for Budget and Cross Checking – E. Jones/EG&G, J. A. Brown/NASA, team leader
- Chart Cost Per Panel Component Only – Kim Ballard NASA/DM-MED-42 by defining major components – valves, filters, etc.
- Work Hours Per Panel Component Chart and Summary Analysis – J. A. Brown/NASA, E. Jones by analysis and summary of all panels government estimates
- Fine Tuning Labor Payroll Taxes & Insurance (PT&I) since rates vary from 15.8% to 150% or an average of 45%
  - We are now re-evaluating each project and using appropriate taxes, such as, Office O/H – 15% to 24%, Elec – 26%, Carp/Conc – 45%, Steel – 57%, Civil –23% to 31%, & Marine – 60% to 100%, J. A. Brown.
- Avoid Sole Source/limited competition by making an additional or double design and bidding alternates and options.
15 New Exciting Estimating Tools Spin-offs (continued)

• “Work Hours for Welding SS Tubing – Astro Heliarc Welding Machine,”
  Jones/Brown
• “OFE/GFE Estimating Cost for Handling, Storage and Insurance, 1 – 10%,”
• “Cost Analysis for Adjusting Cost Indexes for Long Term Escalation,”
  by J. A. Brown
• Fine tuning number of bidder’s concept, J. A. Brown – original concept by Dr.
  Martin Skidmore
• Computerized Cost Escalation Program – January 21, 2002, Gene Hajdaj, J. A.
• How Does the Successful Low Bidder Get Low and Make Money,” by
  Communication Concepts, Cape Canaveral, Florida and Con$truction Co$t
  Con$ultant, Inc., 63 minute video, estimating, construction bid strategies and
  Cost Engineering.
• CD ROMs #1, 2, 3, 4, 5, and 7, 1998 – 2005, Government, Cost Data, 13 seminar
  books, MS PowerPoint™ presentations and computer programs, MS Excel™,
  MS Project™ Documenting many of these government estimating tools.
Tool/Spin-off Number 12

• “Number of Bidders’ Concept” - Introduction - What is the Number of Bidders’ Concept? We have found at KSC:
  1. The more bidders over five means lower bid costs
     • As more prime, subs, vendors, suppliers, etc., give lower, more competitive prices.
  2. Using the number of bidders - it can be shown how the local building economy is doing - more bidders doing a building recession.
  3. By estimating the expected number of bidders, the owner/government can more accurately determine the best markups to have a fair and reasonable estimate for budgets and detailed bid estimates.

• At the KSC construction cost estimating briefing, 12/20/94, it was stated that the number of bidders’ concept showed a KSC building recession from October 1989 to September 1994
  - It ended as the number of bidders decreased from an average of 11 bids to an average of 6.3 bids per KSC construction building projects which may be reason for increased bid costs of 5 to 18% on some projects
  - The speaker went on to say, “What does this mean to the bidding and estimating market?” - turbulence, erratic transitional period of very high and low bids which happened during 1995
Tool/Spin-off Number 12 (continued)

• Tool number 12, “Fine Tuning Number of Bidders’ Concept,” was first discussed at the 1st World Congress presentation of new tools, but was documented in the 1993 Presentation Estimating and Bidding Space Station Processing Facility (SSPF) in Dearborn, MI, and at the Society of Cost Estimating and Analysis, October 8, 1993

  – These technical papers may be the best documentation of a case study showing the use of the number of bidders’ concept and its applications in improving the accuracy of the government estimate

  – It must be noted, the importance of the research of Dr. R.M. Skitmore, with the aid of KSC Lead Cost Engineer, providing R&D projects cost data which was published in the 10th International Cost Engineering Congress in New York, 1988, entitled “Factors Affecting Accuracy of Engineering Estimates.”
Tool/Spin-off Number 12 (continued)

- The charts published in these three technical papers involved sixty-five projects with 429 bids - quite a large sampling
- The KSC Lead Cost Engineer’s comments were based on his experience and applications of the number of bidders chart
- It is suggested that increased bid competition lowers the bid cost 7 to 22% as the number of bidders increase over seven bidders
- In summary of the SSPF case study, listed:
  1. Five ways to help determine the number of bidders for government projects
  2. Special studies and analysis of previous government estimates
  3. Special studies of low bidders, bids, and estimates
  4. Independent analysis of bids - low bid, medium high bids - 3 months prior to bidding
  5. Special analysis and review of the SSPF government estimates
  6. Special data matrix analysis combining five lists to determine the most likely number of bidders
Why Number of Bidders is Important

1. Like detailed planning and scheduling, it forces a detailed bidding analysis.
2. Helps fine tune all mark-ups, OH&P, PT&I, which may vary from 25 to 90% of labor and materials costs.
3. Can help get more bidders, if necessary.
4. Can help get better bidders, if necessary.
5. Helps to ensure bids for special or unique materials, installations, service, systems.
6. After the bids are in, helps explain what happened - why bids were too high or too low.
7. Most helpful in budget estimating and adjusting cost indexes.
8. Adjust your estimates down 25% over 10 bidders, up to 5% - to 10% for special conditions escalation, if only two bidders are expected.
Analysis of/for Government Estimating (SSPF)

1. Number of Bidders, Type and Kind, etc. 0-685 potential bidder from source list
2. Structural Steel – 4,544 tons – $1,500 - $4,000/ton – Used average $2,155
3. Mark-ups – Profit-bond, Prime Mark-up, Material Discounts
4. Overhead/General Conditions – 5-20%, analysis – 9.9%, used 10%
5. Payroll tax and insurance rate fine tune – used 25-30% - varied with each trade – not average for all trades
6. Special conditions analysis – 45 days downtime, 190 of 915 days, joint occupancy, and escalation
7. Analysis of bids, low bids, and government estimates
8. Summary analysis of detail study on government estimating, number of bidders, low bidders, estimating and construction economy market
9. Review of A&E/government estimate- high, low items, need for more and better quotes, break downs, furniture, steel, equipment, 1,025,020 If premise wiring, GFE, sprinkler system breakdown, etc., others
10. Cost per fiber foot of fiber optics cable
11. Cost per panel component
12. Work hours per panel component
13. When SSPF complete, analysis of design, construction, and change orders – 1309, $14 million
14. Labor productivity – efficiency – for detail estimates, and for conceptual budget for future SSPF – Matrix Analysis


## Study of Accuracy of Government Estimates

- **Number of Bidders - Concept**

<table>
<thead>
<tr>
<th>No. of Bidders</th>
<th>No. of Projects</th>
<th>Mean Accuracy (%)</th>
<th>Mean Absolute (%)</th>
<th>Standard Deviation</th>
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<td>-22.66</td>
<td>22.66</td>
<td>0</td>
</tr>
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</table>

University of Salford (England); Dr. Skidmore AACE Int.

Based on our experience and applications the number of bidder chart that increased competition lowers bid cost 7% to 22% as the number of Bidder increases over 5 bidders.
Number of Potential Bidders – SSPF (Fine Tuning # of Bidders)

• Lists of Bidders

1. Source list 31 pages – 685 sets sent
   - Potential Prime bidders? ~30 Bidders?

2. Pre-bid conference, 9/13/90; 14 page list analysis 7 Bidders?

3. Print shops full size drawings and spec sets;
   requests @ $580.00 / set analysis 12 Prime Bidders?

4. Questions from 6 Prime Bidders

5. Dodge reports list 10 Prime’s receiving sub bids

How many Prime Bidders do you think we will get?__________ Why?________

See APB Volume 4 for more details of study and analysis, DVD, Bidding Strategies, and Technical Paper on SSPF for SCEA
List of Prospective Bidders (Fine Tuning # of Bidders)

- Morrison Knudson (3-6s)
- Blount (3L, 4S)
- W&J (3L)
- Walsh (4L, 2PS)
- Auchter (3L)
- F.J. Rooney (4L, 2S)
- Taylor Woodrow (3L, 2S)
- Kiewit (NEB) (3L)
- Fluor Daniel (1L)
- Sauer (4L)
- George Hyman, Tampa (4L 4 sets)
- University Mechanical Natl. (3S)
- Metric Const., Tampa (2L)
- Caddell Const., Ala (3L)

(Number of drawing sets ordered from blue print company)
(Number of sets of specification from blue print company)
(L = number of lists potential prime bidder were on)

14 Potential Prime Bidders by JAB Analysis
Seminar 6 Workbook

Seminar 6: Aerospace Futuristic Cost Estimating

Aerospace Pre-Conceptual Futuristic Facility & GSE Cost Estimating:
Cost Modeling for Next Generation Launch Technology to ISS and the Moon
For Engineers, Contractors, Estimators, Educators, Aerospace Managers

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01-09-2007, 01-09-2007
JAB Volume 18

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20 Projects

Processing Fac

Structural Steel

Launch Pad

University Dorm

High School

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Seminar IV
Volume V
List Price $140.00
How to Make Conceptual GSE Estimates

1. Identify Problem Or Need for GSE
2. Determine Purpose of GSE
3. Determine Requirements
4. Assemble Team with The Appropriate Knowledge and/or Disciplines for Project (May include some or all of the following: Project Engineers, System Engineers, Architectural Engineers, Structural Engineers, Mechanical Engineers, Electrical Engineers, Interfacing Systems Engineers, Cost Engineer)
5. Develop Cost Estimate
6. Review the “20 Important Considerations for GSE Cost Estimating”
7. Submit For Independent Review and Approval

Type of Cost Estimate Developed
1. Base on Previous Buys, Design, Fabrication, Assembly Bid, Adjusting for Design, Escalation, and/or Location
2. Conceptual Computer Model Design
3. Combination of #1 & #2
4. Swag it – Scientific Wild ‘A’ Guess
5. Other

Note:
Add to Cost Estimate for Testing (LETF Quote), Mark-ups, FPC, Support Contractor, Contingencies, Escalation, Design Activation, etc.
Planned Polygenerator Facility Site North of VAB Oxygen, Hydrogen, Nitrogen, Electrical Power Study Nov. ’83 QROME $151 Mil, Escalated to April 2012 $457 Mil by JAB/CCCI/Computer Prog
## OSB Project Summary

### System Summary of Detailed Combined Fund Estimate

<table>
<thead>
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<th>DIV. TITLE</th>
<th>QTY</th>
<th>UNIT</th>
<th>$SSBF</th>
<th>TOTAL</th>
<th>DIV. TOTAL</th>
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<td>4.A. Mechanical</td>
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<td>6. Structural Steel</td>
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<td>8. Roofing</td>
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<td>9,753</td>
<td>Jamb</td>
<td>15.93</td>
<td>159,693</td>
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<td>-</td>
<td></td>
<td></td>
<td>15,930</td>
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</tbody>
</table>

### General Conditions
- **Bldg Type**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Notes**: 6. **CURED ON-SITE**: Utilized Business Zone

### Work Order/Contract
- **Billing Resistance**: 10.00/10.00/10.00/10.00/10.00/10.00
- **Note**: 1. **Revised General Conditions**: too high

### Specific Features
- **Bldg 3**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Note**: 7. **GENERAL**: Utilized Business Zone

### Construction Bid Data (10/05-09/21)
- **Total Bldg**: $190,000
- **Architect/Struct**: 70.02 BIF $13,790,370
- **General Contractor**: 15.70 BIF $2,861,916
- **Interior Elect**: 8.04 BIF $541,562
- **Interior Plumbing**: 10.06 BIF $25,305,000
- **Total Exterior**: 26.13 BIF $4,800,000

### Notes
- **Bldg 3**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Note**: 3. **RISING triples**: Utilized Business Zone

### General Notes
- **Bldg 3**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Note**: 8. **GENERAL**: Utilized Business Zone

### Special Notes
- **Bldg 3**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Note**: 9. **GENERAL**: Utilized Business Zone

### Construction Notes
- **Bldg 3**: Steel frame, precast concrete panels and window band, "CAPACITY": 1,000 people, "_________________________________________________________________________"
- **Note**: 10. **GENERAL**: Utilized Business Zone

---

**Note**: All billings are based on the total project cost. The final amount may vary based on the actual work performed.
### System Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>CRV*</th>
<th>Type</th>
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<td>J8-7708</td>
<td>$297,912,539</td>
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<td><strong>Critical Systems</strong></td>
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<tr>
<td>High Pressure GH2 Facility</td>
<td>J8-1462</td>
<td>$1,557,381</td>
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</tr>
<tr>
<td>LOX Facility</td>
<td>J8-1502</td>
<td>$21,227,745</td>
<td>GSE</td>
</tr>
<tr>
<td>Liquid Hydrogen Facility</td>
<td>J8-1513</td>
<td>$11,496,814</td>
<td>GSE</td>
</tr>
<tr>
<td>Electric Eq. Bldg #2 (LOX)</td>
<td>J8-1553</td>
<td>$4,284,930</td>
<td></td>
</tr>
<tr>
<td>Electric Eq. Bldg #1 (RP1)</td>
<td>J8-1563</td>
<td>$1,523,510</td>
<td></td>
</tr>
<tr>
<td>Water Tank - 300,000 Gal?</td>
<td>J8-1610</td>
<td>$5,011,535</td>
<td></td>
</tr>
<tr>
<td>Flares Stack</td>
<td>J8-1611</td>
<td>$898,133</td>
<td></td>
</tr>
<tr>
<td>RP1 Facility - Mothball?</td>
<td>J8-1613</td>
<td>$7,443,740</td>
<td></td>
</tr>
<tr>
<td>Compressed Air Bldg</td>
<td>J8-1659</td>
<td>$2,765,994</td>
<td></td>
</tr>
<tr>
<td>Slidewire Termination Bldg</td>
<td>J8-1703</td>
<td>$2,554,218</td>
<td></td>
</tr>
<tr>
<td>Sewage Treatment Plant #5</td>
<td>J8-1705</td>
<td>$1,000,529</td>
<td>57,000 gal.</td>
</tr>
<tr>
<td>Remote Air Intake Bldg</td>
<td>J8-1753</td>
<td>$2,802,484</td>
<td></td>
</tr>
<tr>
<td>Camera Pad #2</td>
<td>J8-1714</td>
<td>$240,483</td>
<td></td>
</tr>
<tr>
<td>Hypergol Oxidizer Facility</td>
<td>J8-1862</td>
<td>$916,789</td>
<td>GSE</td>
</tr>
</tbody>
</table>

SubTotal: $63,724,285

### Pad & Major Items

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>CRV*</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated Design</td>
<td></td>
<td>$36,163,683</td>
<td>10%</td>
</tr>
<tr>
<td>SGAA</td>
<td></td>
<td>$39,780,051</td>
<td>10%</td>
</tr>
<tr>
<td>Contingencies - Change Orders</td>
<td></td>
<td>$109,395,139</td>
<td>25%</td>
</tr>
<tr>
<td>Activation</td>
<td></td>
<td>$273,487,848</td>
<td>50%</td>
</tr>
</tbody>
</table>

SubTotal: $546,975,697

### June 30, 2003 Estimated Bid Cost

- **$820,463,545**
  - Environmental site work, roads: $1,001,121,446
  - Utilities, cable trays, GN2, Comm, Crawlways, Crossings, Parking, etc.: $1,021,942,482

*CRV=Current Replacement Value*
Installed Fiber Optic Cable Costs – New Exciting Estimating Tool

- **Average Cost Summary Chart** – [per fiber meter (FM) and per fiber foot (FF)]

<table>
<thead>
<tr>
<th>SIZE OF PROJECT</th>
<th>FM AVERAGE COST</th>
<th>BY FIBER METER (/fm)</th>
<th>BY FIBER FOOT (/ff)</th>
<th>FF AVG. COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>0.96</td>
<td>.72 - $1.53</td>
<td>.30 - .45</td>
<td>0.34</td>
</tr>
<tr>
<td>Medium</td>
<td>0.67</td>
<td>.61 - .72</td>
<td>.19 - .22</td>
<td>0.205</td>
</tr>
<tr>
<td>Large</td>
<td>0.46</td>
<td>.36 - .47</td>
<td>.11 - .15.5</td>
<td>0.13</td>
</tr>
</tbody>
</table>

- **Overall Average** = .688 / fm – (.17 / ff)
  - Small size projects – Less than 600,000 fiber meters
  - Medium size projects – 600,000 to 1.5 million fiber meters
  - Large size projects – over 1.5 million fiber meters
Sample Panels - Cost per Component Fast & Easy
• Ocean launch picture
• Cost Reductions:
  – No Down Range Tracking Facilities needed, can be tracked by satellite.
  – Reduced government paperwork, rules, policies
  – Time saving - reduced downtime for other launches
  – Reduced personnel for operations and launching
  – Reduced air traffic for remote ocean launch platform
• Cost Factors for Facilities, GSE and O&M 2/15/2002 JAB/G. Hajdaj. (Ref #34)

- **Ship and Shoot Concept using liquid propellants**
  - No need for Acid Protection

- **Reduced Cost – Clean Pad Concept:**
  - No Towers needed
  - No Pad Clean Rooms needed
  - No Sound Suppression System
  - No Lightning Protection needed
  - No GN2 Explosion Proof Components needed
  - No Protective Coating & Painting needed
  - No Extra Weather Protection needed
  - No Cranes needed

- **Example – Launch Pad Costs:**
  - 1996 Florida Spaceport Launch Pad $6 M
  - 1997 California Space Port Launch Pad $20 M
  - 1998 Kodiak Alaska Launch Pad $40 M
  - 1967-1985 Apollo / Shuttle Launch Pad $121 M – ROM $2 Billion Budget
  - 2003 EELV (Each Pad 37/41) $300 M (Each Pad)

CLEANER AND SAFER LAUNCH PAD
Computer Programs / IT

- A tool to project cost data is a computerized cost escalation program that escalates all KSC cost data since year 1974 to year 2012
- Simple 4-step or 18-step program for lump sum projects, for multi-billion dollar projects or unit prices
- Cost can be fine-tuned using the Analysis Matrix Estimating Tool
- See Escalation Chart

**EXCEL ESCALATION CHART FOR PROJECTS 1974 - 2012**
**BASED ON JAB KSC COST INDEX - TOTAL LABOR & MATERIAL**

**PROJECT NAME: KSC VAB/ LC-39**
**DATE: 04-12-2002**

Enter …
Month and year of known project  
*(must be date between 1/74 and present)*  
Cost of known project (did cost)  
Month and year of new project  
*(must be date between 1/74 and 12/2012)*

Then …
Index for known project =  
Index for new project * =  
Index ratio new/known =  

Projected cost of new project (will cost) =  
Cost of known project x ratio =  
**$ 774,369,491**

**ECBC**
**OTHER**

**NOTES**
All escalation factors from October 2001 to Dec 2012 are based on 4% per year estimated escalation.
Use unit price chart (next sheet) for square foot and cubic foot unit prices.
Enter date formats as first three letters of month and last two digits of year.
For dates beyond 2000, enter date format with all four digits of year.
If chart does not work, check data table to see if the month entered is available.
If month is not available, use closest available month.
* Check index backup data.

See Refs #28 & 35, Past, Present, and Future Aerospace Computer Programs for escalation 1974-2012
This program developed and documented by Gene Hajdaj and Joe Brown
System Cost Summaries – Construction: Central Operations Facility (C of F)

- Activation Costs

<table>
<thead>
<tr>
<th>CONSTRUCTION COSTS</th>
<th>QTY</th>
<th>UNIT</th>
<th>$UNIT</th>
<th>$TOTAL</th>
<th>DLV. TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SITE WORK</td>
<td>14.14</td>
<td></td>
<td></td>
<td>137,249</td>
<td></td>
</tr>
<tr>
<td>2. CONCRETE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. MASONRY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. METALS</td>
<td>3.72</td>
<td></td>
<td></td>
<td>35,076</td>
<td></td>
</tr>
<tr>
<td>5. WOOD/PLASTICS</td>
<td>1.86</td>
<td></td>
<td></td>
<td>16,011</td>
<td></td>
</tr>
<tr>
<td>6. DOORS &amp; GLASS</td>
<td>139</td>
<td></td>
<td></td>
<td>77,950</td>
<td></td>
</tr>
<tr>
<td>7. FINISHES</td>
<td>11.34</td>
<td></td>
<td></td>
<td>195,964</td>
<td></td>
</tr>
<tr>
<td>8. SPECIALTIES</td>
<td>18.75</td>
<td></td>
<td></td>
<td>190,574</td>
<td></td>
</tr>
<tr>
<td>9. EQUIPMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONSTRUCTION COST DATA**

- **DEMOLITION**: $137,249 (22.2%)
- **FACILITY C of F**: $193,190 (31.1%)
- **ACTIVATION COST**: $2,002,116 (32.5%)

**KSC SPCLZD. CONSTR. - ACTIVATION**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>1</td>
<td>Equipment</td>
<td>1,114,738</td>
<td>$2,002,116</td>
</tr>
<tr>
<td>Service Vendor</td>
<td>1</td>
<td>Service</td>
<td>472,165</td>
<td></td>
</tr>
<tr>
<td>Furniture</td>
<td>1</td>
<td>Furniture</td>
<td>342,549</td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td>1</td>
<td>Travel</td>
<td>42,240</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>1</td>
<td>Training</td>
<td>30,423</td>
<td></td>
</tr>
</tbody>
</table>

- Diagram: Central Operations Facility (C of F) Activation Costs.
Application of JAB Estimating Tools - APB Sys. Summaries

New Concrete Office Bldg 30000 SF

**E C C P**

- **Average Cost**: $169
- **Average + SD**: $190
- **High Cost**: $244

**Escalated ECCP**

- **Average Cost**: $5,335,200
- **Average + SD**: $5,986,000
- **High Cost**: $7,689,300

**E C C E**

- **Average Cost**: $216
- **Average + SD**: $242
- **High Cost**: $311

**Escalated CCE**

- **Average Cost**: $6,482,200
- **Average + SD**: $7,273,000
- **High Cost**: $9,342,500

Test by Glen Butts and Dallas Lee
Application of JAB Estimating Tools - APB Sys. Summaries

![Bar Chart: Today's ECCP Cost By CSI Division]

<table>
<thead>
<tr>
<th># of Stories</th>
<th>Site Development</th>
<th>Finish</th>
<th>Engineering</th>
<th>Estimate #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>40.0046</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Bidders</th>
<th>Project Bid Date</th>
<th>Project Location</th>
<th>Lead Level</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Sep-06</td>
<td>KSC</td>
<td>None</td>
<td>Normal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CCE Including Design (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Avg + SD</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
<tr>
<td>Median</td>
</tr>
</tbody>
</table>

- Average $7,130
- Avg + SD $8,000
- Maximum $10,277
- Median $6,993

Estimates are based on historical projects, and exclude activation costs which can be substantial.

9/12/2005 2:46 PM
2005 - 107 TEST Cost File.xls
Glenn Butts

Test by Glen Butts and Dallas Lee
The Moon/Mars program could help solve: falling U.S. dollar; U.S. growing trade deficit; growing budget and spending, local and world wide global warming, and growing pollution problems.

Some Solutions - Education of American public on these problems and possible solutions

• **Continuing productivity improvement**, such as computerization has helped since the 1970’s and future CAD/cost engineering 5D. (cost estimating, scheduling, cost control).
• **Developing a new 2 trillion dollar industry** that is pollution and radiation free that the US has most (nuclear) experience in, such as the moon mining of Helium 3.
• **US to build 100 - 1000 megawatt power plant**, 15 billion each, QROME (Quick, Rough, Order of Magnitude Estimate) and exporting to the world 1100 - 1000 Megawatt Power Plants, 15-25 billion each, and selling them at a profit. 1 to 20 moon flights per year at $1-2 billion dollars each to bring back Helium 3 (5,000-50,000 lbs/flight). Also new tourist industry, vacations, and honeymoons, and medical surgery and recovery, and advertising from the moon.
• **Worldwide use of Helium 3** can be an economic boost to the US and world wide economy, improving the US trade/budget deficits. Also diversified energy independence “DEI”. One shuttle (65,000 lbs) load of Helium 3 can power the US electrically for one year.
1. In 1955, JAB stationed in Germany was taking a photography workshop with a very good German teacher. An important comment was made concerning European and world pollution, "It’s better to take pictures after a good rain as it cleans the air of pollution and gives a sharper image, in black and white and color." It would appear this is also true in many major industrial US cities, as well as other world-wide metropolitan areas. Therefore, the clean energy sources from Helium 3, solar, and wind are critical for a healthier environment and human existence.

2. Diversified energy independence such as solar power satellites, moon mining of Helim-3, clean coal energy and wind are important to save our oil and gas industries for automobiles, plastics, etc. Also to reduce oil monopolies - the US is presently using coal for fifty percent of our electrical energy. Answer & Solution Chart?

3. Comments: Peer review was “inspiring, and we need some inspiration now with the global warming, a threatening energy crisis and that national debt we don't want to talk about.
What should be used for high cost escalation for the NASA KSC Space Program to the Moon & Mars Facilities and GSE?

- Consider using 5% to 10% per year, but on major multi-year projects that are heavy weighted in concrete, steel, rebar, copper, asphalt, and aluminum do a cost analysis, or get quotes on major cost items.

- Remember that impact, scheduling delays, and change order will cost extra for time extensions.

- Escalation may last for several more years, but now there is some hope for relief.

- February 2007 international stock market melt-down may cause more time needed to evaluate the effects on world trade and commodities, etc. An analysis update will be required.
We must continue educating the American people on the importance to the US economy, world pollution, productivity, cost engineering, and an accelerated space program for the continued success of our country.
Questions and Answers
Thank You!

A Special Thank You to AACE, KSC, USA, CCCI and team members for your support.

Joseph A. Brown, CCE President
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Merritt Island, Florida 32954-3175
(321) 452-4909

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www.spacevisionscongress.com