Engineering Consulting

Semiconductors

Flat Panel Displays

Photovoltaics

Nanotechnology

Microelectronics

MEMS

Biotechnology

AGI Abbie Gregg, Inc.

1130 East University Drive, Suite 105 | Tempe, Arizona 85281 USA
P: 480.446.8000 | F: 480.446.8001 | agi@abbiegregg.com | www.abbiegregg.com

Abbie Gregg, Inc.

- AGI provides facility, process, industrial, and operations consulting engineering and design services.

- Industries Served:
  - Microelectronics
  - Semiconductor
  - Flat Panel Display
  - Flexible Electronics
  - Photovoltaics
  - Disk Drive
  - MEMS
  - Nanotechnology
  - Biotechnology
  - Medical

AGI can assist at every stage.

= Client needs

= AGI services

Start Up Consulting

Research & Design

Manufacturing

Technology Evaluation
- Validation: Process / Product Analysis
- Intellectual Property Strategy
- Fair Market Valuation
- Market Analysis

R&D Options

Manufacturing Options

Collaboration

Dedicated Lab

Make

Buy

- Site Selection
- Facility Design
- Equipment Evaluation / Procurement
- Cost Modeling
- Tool Installation / Accommodation
- Locate Funding Partners

- Site Selection
- Plant Design
- Tool Evaluation
- Cost / Capacity Modeling
- Technology Transfer
- Tool Installation
- Process Start Up
- Yield Improvement

- Partner Search
- Procurement Specification
- Cost Modeling
- Technology Transfer

Services Provided

- Facility Start Up
- Process Engineering
- Industrial Engineering
- High Tech Business Consulting

Facility Start Up

- Equipment Specification and Selection
- Site Search, Evaluation and Selection
  - Vibration, EMI, Acoustical Analysis
  - Tax and Incentive Analysis
- Cleanroom, Labs, Imaging Area Layouts
- Utility Matrix: FabTech© Software
  - Hazardous Materials Analysis
  - Chemical and Gas Usage Studies

Facility Start Up

- Cleanroom and Lab Design and Specification
- Tool Installation / Hook-up
- Sourcing Cleanroom Products and Services

Process Engineering

- Process Analysis
- Manufacturability Analysis
- Technology Transfer, Documentation, Training
- Process and Equipment Optimization / Qualification
- Contamination Control Audits
  - Isolation Technology / Minienvironments

Roll to roll manufacturing of cosmetic patch with integrated flexible battery.

Industrial Engineering

- Cost and Capacity Models
  - Product and Factory Cost
  - Capacity Studies
  - Operating Cost Analysis
  - Cycle Time Reduction
- Measurement and Control Systems
  - Specifications
  - MES
  - Work Flow Control
  - Training Systems
  - SPC
- Specialty Tool and Line Automation
  - Roll to roll handling of flexible substrates
  - Unusual substrate or tool types

AGI's Programming Approach

Workshops, Tours, and Data Collection

- Discussion with users:
  - Tour Existing Labs and Cleanrooms
  - Find out how current facilities limit research results.
  - List products or research to be generated
  - Examine client's newest and future requirements
  - List the constraints (Budget, Schedule, etc.)
- Review the client's tool list. – Current? Future? Suggestions…

AGI creates a bridge between user process needs and the design team

- Develop layout
- Develop utility matrix
- Develop room conditions matrix
  - Lists the room's temperature and humidity requirements
  - Lists the square footage of each room
  - Lists the vibration requirements
  - Lists light and noise levels
  - Lists the EMI requirements
- Studies on EMI/Vibration abatement customized for site/tool/user requirements.
- Analyze Chemical/Gas Usage
  - HPM – code issues, storage and operational plans.

AGI's Programming and Design Approach

User Interaction

- "Live" CAD Edits
- Link to Mechanical/Architectural/Structural Systems
- Benchmark Costs
- Benchmark Performance
- Photograph Studies
- Tour, Touch, Feel, See
- Continue to evaluate user group needs – refine requirements – observe work spaces.

Interface with Design Team

- Insure design meets owner's needs
- Insure tools will operate within designed facilities
- Value engineering/difficult designs

Interface with Owner – Ongoing

- Discuss tool changes
- Discuss process changes
- Impact on design
- Discuss Student, Researcher and Facilities Changes.

Design Services provided by AGI

- Specialty systems (Gas cabinets, specialty gases, abatement)
- DI Water, Waste Treatment, Specialty Liquid/Drain Systems
- Laboratory Design
- Cleanroom MEP support
- Fixtures, furnishings, wet process stations
- Construction Visits, Construction Administration
- Tool install design

Building Information Modeling (BIM) Revit Architectural Services

- **Building Information Modeling (BIM)**
  - Building design and documentation methodology
  - Fully integrated with AutoDesk Revit® software
  - Enhanced real time coordination between all design disciplines
  - Predicts appearance, performance and cost
  - Identifies physical conflicts
  - Critical for tightly packed spaces, like cleanrooms
- **2 Revit Projects Completed**
- **BIM tools in use since 1986**
  - FabTech© Utility Matrix
  - CAD Tool Library

AGI Revit Rendering of UMass Lowell ETIC Cleanroom

Example of Physical Conflict

Construction Supervision

- Construction Administration
  - RFI's
  - Shop Drawing and Material Approval
  - Expedite and coordinate crating and shipping of all material to the site.

- Onsite Supervision of:
  - Turnkey Contractor
  - Architectural, Structural Contractor
  - Electrical and Mechanical Contractor
  - Tool Hook-up Contractor

Construction Supervision

- Scope:
  - Cleanroom Flooring
  - Cleanroom Recirculating Air Handling Units (RAHU)
  - Specialty Make up air treatment systems
  - Cleanroom Ceiling
  - Process Piping
  - Walls and Doors
  - Electrical Panels / Distribution
  - HPM Storage / Distribution / Treatment
  - Contractor Furnished Equipment Placement.
- Commissioning: Testing Adjusting and Balancing followed by Cleanroom Certification and Acceptance.

Construction Supervision

- Onsite Construction Coordination
  - Clean build protocol- 3 stages
  - Cleanroom slab, Vibration isolation and Cleanroom Flooring
  - Cleanroom Air handling systems and Catwalks.
  - Cleanroom ceiling and walls
  - High purity piping (orbital welding and Teflon pipe fusion)
  - Process systems coordination
  - Cleanroom equipment and furnishings Coordination
  - Personnel Coordination

Operational Excellence

- **LEED**
  - Design for energy efficiency
  - Challenges of HVAC intensive areas (cleanrooms, HPM areas)

- **Commissioning**
  - Testing, Adjusting and Balancing - HVAC
  - Process Piping Purity
  - TGM and Fire Alarm / EHS
  - HPM Storage and Dispense Systems
  - Cleanroom Certification
  - Vibration / EMI / Acoustics Testing

AGI LEED Projects:

- **Arizona State University**, Biodesign Institute, Phases I & II
  - Building B, LEED Certified: Platinum
- **King Abdullah University of Science and Technology,** Advanced Fab Cleanroom, Photovoltaic Research Lab, Thin Films Lab
  - LEED Certified: Platinum
- **Lawrence Berkeley National Labs**, Molecular Foundry
  - LEED Certified: Gold
- **Duke University**, Fitzpatrick Center for Interdisciplinary Engineering, Medicine and Applied Sciences (FCIEMAS)
  - LEED Certified: Silver

A KAUST Solar Cooling Tower exterior view. The tower uses the sun and prevailing winds to create a passive pressure difference and continuous breeze along shaded courtyards.

Tool Procurement Services

1. Develop RFP (Request for Proposals)
2. Selection of tool vendors
3. Negotiate tool acceptance criteria / final tool specification.
4. Assist with tool source inspection.
5. Assist with planning for tool hook-up and tool delivery.
6. Prepare tool book and electronic file for each tool with all documentation for use by the Equipment Engineering department as a history of tool procurement through start-up.
7. Tool Commissioning, Tier 1, 2, 3 Acceptance

AGI Abbie Gregg, Inc.

Engineering ♦ Consulting ♦ Technology ♦ SEMI ♦ FPD ♦ BIO ♦ NANO
(480) 446-8000 ♦ Fax (480) 446-8001 ♦ www.abbiegregg.com
1130 East University Drive, Suite 105 ♦ Tempe, Arizona 85281-8403

Request for Vendor Input to Specification for:

Clean Three-Tube Furnace Bank

AGI Project Name: KAUST
AGI Project number: 0634E

Specification Release Date: 02/03/09
Amended Specification Due Date:02/06/09
Revision Date: 02/09/09
Revised by: GCH

Vendor Contact Information:

Prepared by: (All replies to be sent to:)

[AGI Consultant Contact Info]

Abbie Gregg, Inc.
1130 E. University Drive, Suite 105
Tempe, Arizona 85281
Phone: (480) 446-8000
Fax: (480) 446-8001

ditions in this RFP

Factory Acceptance Test

Tool Procurement
Successful AGI Negotiations

- All tools now commissioned – no change orders.
- Timing – Economy dependent.

Number of Tools	Initial Bid $$	Final Bid $$	Price Reduction (%)
116	$40,193,608	$30,317,893	25%
Negotiated Price Reduction Between First and Final Bid:			**$9,875,714**

High Tech Business Consulting

- Market Studies
- Make / Buy Analysis
- Fair Market Valuations and Due Diligence Analysis
  - Technology
  - Equipment
  - Start Up Companies
  - Facilities / Sites
- Manufacturing Partner Searches
  - Foundry Selection
  - Sourcing of Fabrication, Test and Assembly Services
  - Product Specification Development
- Turnarounds / Expansions
  - Temporary Talent

Software Products
AGI Modeling Suite

- **Jupiter ©**
- **Pluto ©**
- **CARME ©**
- **eValuate ©**
- **FabTech ©**
- Licenses and Databases available

AGI Background

- Started in 1985
- Based in Phoenix, AZ
- Approximately 650 Projects Completed in North America, Europe, Asia, the Middle East and Australia

Benefits of Using AGI

- Reduce and control operating costs.
- Free resources for other tasks during peak activity loads.
- Gain access to state-of-the-art capabilities.
- Bring fresh perspective and objectivity.
- Easy access to AGI staff of Process Engineers, Industrial Engineers, Computer Modelers, Operations Managers, Professional Design Engineers, CAD Designers and Specialty Consultants.

Client Testimonials

"…Thank you for being so caring about this project. You have been working day and night for the best interest of KAUST Project. Thank you again."

~ Tawfeeq Aljohani, Lead Project Engineer, Academic Buildings & Laboratory Division, King Abdullah University Projects Department, KAUST

"…I second Tawfeeq in his comments and I extend my appreciation to you and your team for the commitment and dedication you are putting in KAUST project.

~Abdulla M. Al-Saleh, Sr. Project Manager, Academic, Administration & Laboratory Buildings Division, ASC Company Representative (Head of Project for Aramco), Aramco Overseas Company B.V.

"Thank you for the model…I appreciate the effort your team put in to make this happen. I know it was challenging to put together with busy schedules."

~ Rick Brinkley, Staff Engineer, Qualcomm MEMS Technology, April 2006

"I can speak for AGI…[they] have been involved with just about every nanotech project that matters…AGI is a good partner for many of the advanced technology facilities."

~ Jeff Schantz, Vice President Science + Technology, HOK, January 2006

"…your company was the most professional team that I have ever worked with…I always recommend working with you."

~ Doron Marco, Tulip Biotech, formerly of Citala, December 2005

"We continue to use [AGI's] FabTech Utility Matrix and it has been very useful to us."

~ Jim Beal, Sandia National Laboratories, MESA Project, November 2005

"I believe this is the most thorough and clear SD design narrative I have seen in my 15 years at UM. Very Good Job!"

~ Ken Berringer's University of Michigan Owner Review Comments, August 2004

Engineering Consulting

Semiconductors

Flat Panel Displays

Photovoltaics

Nanotechnology

Microelectronics

MEMS

Biotechnology

AGI Abbie Gregg, Inc.

1130 East University Drive, Suite 105 | Tempe, Arizona 85281 USA
P: 480.446.8000 | F: 480.446.8001 | agi@abbiegregg.com | www.abbiegregg.com