CASTRO
ROOFING OF TEXAS

TEXAS INSTRUMENTS RFAB BUILDING

2006 GOLDEN HAMMER AWARDS

CASTRO
ROOFING OF TEXAS

Texas Instruments | Technology for Innovators™

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Project: Texas Instruments RFAB Building

Big Thirst!
New RFAB Plant Will Reduce Water Consumption By a Third In a Drought Area

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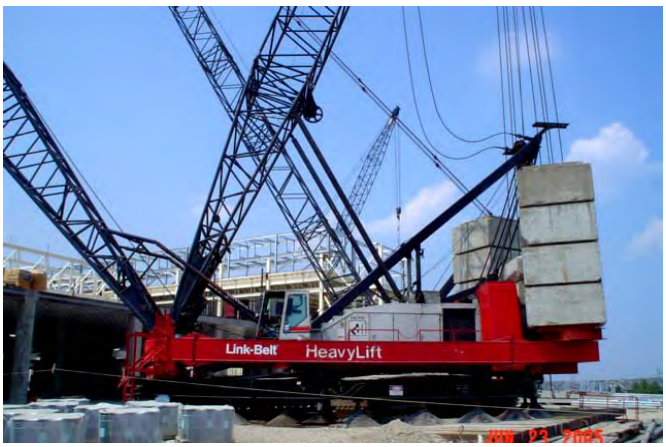
ENTRY FORM



Starting Point

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Golden Hammer Application

Know someone who is outstanding in the field. Want to honor an industry leader? Here is the call for entries for the 2006 Golden Hammer Awards.

Background
The Golden Hammer Awards Program brings annual recognition to NTRCA contractor and associate members. These members will be recognized by their peers for their significant contribution to the roofing industry in the following categories.

Outstanding Residential and Commercial Projects: Three awards will be presented in each of these categories. Your entry could be based on: logistical challenges, quality workmanship, uniqueness, difficulty, time constraints, innovative solutions, safety challenges, or anything else you feel caused your projects to be unique.

Outstanding Community Service Project: Three awards will be presented for outstanding community service projects.

Eligibility
Unique roofing related projects, programs, services, etc. completed between December 1, 2005 and December 15, 2006 are eligible for entry.

Deadline
The deadline for entries is **December 18, 2006**. Winners will be announced at the NTRCA's 7th Annual Awards Banquet in 2007.

Entry Preparation
Your entry/application will consist of the following items:
1. An entry form along with a description of the job, program or event. Please describe what made this job or event so unique that it should be considered for a Golden Hammer Award.
2. Descripton of the job being considered an any relevant materials. Photographs are required – other supporting documents may be submitted, but only if they describe the uniqueness of the project.
3. Please remember the only information the judges will have to make their decisions is the pictures and information received in the entry.
4. Applicants are responsible for all shipment and postage in sending entries to NTRCA.
5. All entries become the property of NTRCA. DO NOT SEND IRREPLACEABLE MATERIALS!

Mailing Address
Entry forms and supporting documents must be mailed to NTRCA
Golden Hammer Awards
PO Box 9526
Fort Worth, Texas 76147

What Happens to Entries?
1. Entries are screened to verify eligibility.
2. Recognized industry experts serve as judges and evaluate each entry.
3. The highest ranking entries in each category will determine the winners of the Golden Hammer Awards.
4. The decisions of the judges are final and scores for individual entries will not be disclosed.
5. The Industry Leadership Award and Associate of the Year will be decided by the NTRCA Board of Directors base on nominations received from NTRCA members.

Must be postmarked by December 18, 2006

2006 NTRCA Golden Hammer Awards Official Entry Form

(Check one of the below)

_XXX__Outstanding Commercial Roofing Project
___Outstanding Residential Roofing Project
___Outstanding Community Service Project

Contractor's Name: CASTRO ROOFING OF TEXAS

Address: 4854 OLSON DR.

DALLAS, TX 75227

Phone Number: 214.381.8108

Name of Project: TEXAS INSTRUMENTS RFAB BUILDING

Project Owner: TEXAS INSTRUMENTS

Project consultant, engineer or architect (if any): PageSoutherlandPage ARCHITECTS

List the NTRCA associate members involved: GAF - SARNAFIL - D/FW ROOFING SUPPLY

Date of commencement: April 2005 Date of completion: November 2006

On a separate piece of paper, describe the project. Include information concerning its unusual design, time constraints, difficulty factors and/or problems you may have faced.

Attach five 5x7 photos showing the project from different angles and in various phases of progress. All materials submitted become the property of NTRCA.

Projects must have been completed between 12/1/05 and 12/15/06.

Submitted by: Rodolfo Rodriguez

Title: President Date: December 26, 2006

DESCRIPTION

Front Entrance - Conceptual Drawing

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CASTRO
ROOFING OF TEXAS

GENERAL INFORMATION

TEXAS INSTRUMENTS RFAB BUILDING

PROJECT OWNER'S NAME/ADDRESS:

Texas Instruments
300 West Renner
Richardson, Texas 75080

White Roof

ARCHITECT:

PageSoutherlandPage Architects
3500 Maple Avenue #600
Dallas, Texas 75219

GENERAL CONTRACTOR:

Austin Commercial
3535 Travis St. #300
Dallas, Texas 75204

SYSTEM TYPES:

PVC ROOF SYSTEM:

- Seal all metal deck side and end laps with ice & water shield to prevent dust from entering the building.
- Mechanically fastened 2.7" Polyisocyanurate insulation. Installed a second layer of 2.7 " Polyisocyanurate insulation with Olybond Adhesive.
- Install ½" Dens Deck Primed using Olybond Adhesive.

- Sarnafil G410 - 72 mil fully adhered system.

MODIFIED BITUMEN MEMBRANE:

- Primed concrete deck and hot mopped 1st layer of 2.8" Polyisocyanurate insulation.
- 2nd layer of 2.8" Polyisocyanurate insulation hot mopped.
- ½" High Density Fiberboard hot mopped.
- Install 3-Plies of GAFGlas Flex 6 Premium fiberglass felts hot mopped.
- Install 1-Ply of GAF Ruberoid **Energy** Cap Sheet - 30FR hot mopped.

OTHER:

- 24 Gauge Stainless Steel sheet metal trim
- Fall protection per OSHA requirements
- Custom wood blocking
- Metal siding around perimeter of exterior wall system
- Temporary roof system
- Internal gutter system with roof drains
- Seal all metal deck side and end laps (dust control system for the FAB Building)

SIZE OF PROJECT:

SBS Modified Asphalt Roofing = 240,125 square feet
PVC Membrane Roofing = 250,800 square feet
Total Square Feet 490,825 square feet

LENGTH OF PROJECT:

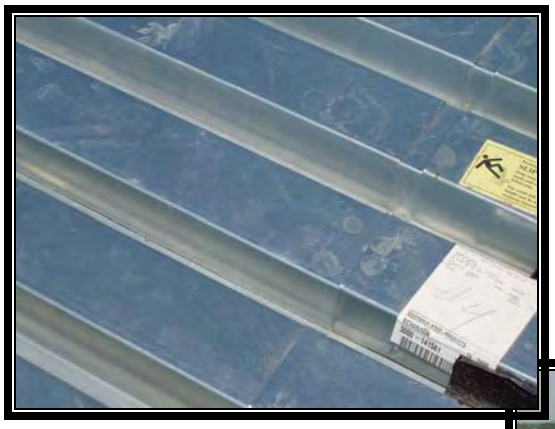
185 calendar days

COMPLETION DATE:

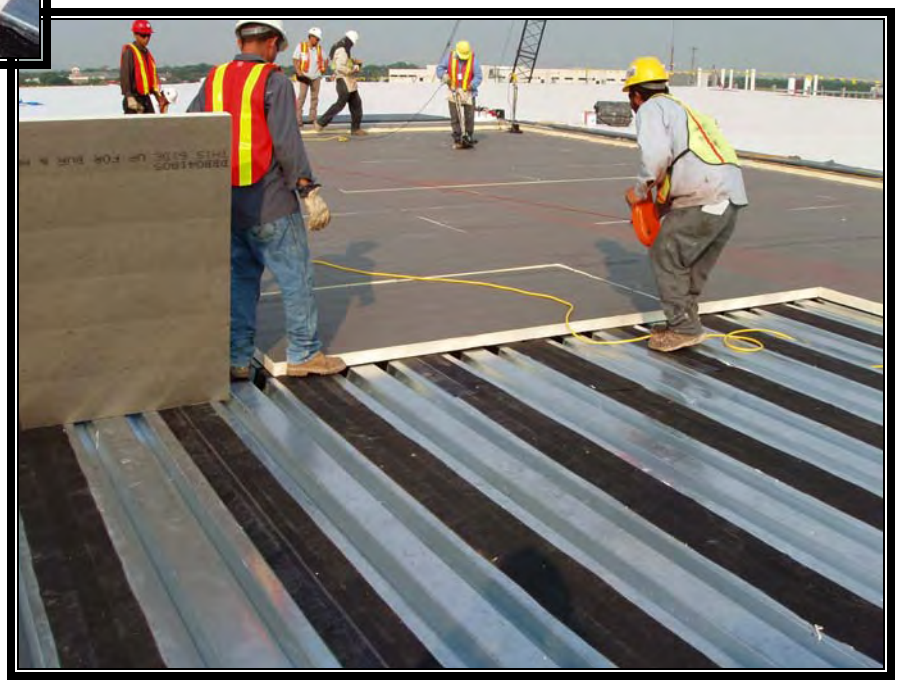
November 2006

PERCENTAGE OF SELF-PERFORMED WORK:

100%



Ice & Water Shield Installed at End Laps, Side Laps and At Perimeter of Metal Deck



Texas Instruments RFAB Building is composed of 101,200 square feet of roof, 6 roof elevations, and two different roof systems (hot mopped 3-Ply felts + 1-Ply Energy SBS Cap Sheet and 72 mil fully adhered PVC membrane. Close coordination was maintained throughout the project with multiple trades and the general contractor to ensure a successful project.

The metal deck over the FAB building had to be maintained dust free for proper fabrication of high tech chips. To help eliminate future dust entering the manufacturing facility, ice and water shield was installed at all side laps and end laps of the metal deck. Prior to installing the roof system, the ice and water shield had to be carefully inspected. The inspection was done during the early morning while still dark. The light of the interior of the building was used to inspect for any light coming through the metal deck.

These and other challenges were overcome due to focusing on the customer's expectations and needs. The project was completed on time and on budget. But more importantly, the customer, architect and customer's representatives were satisfied with all phases of our scope of work.

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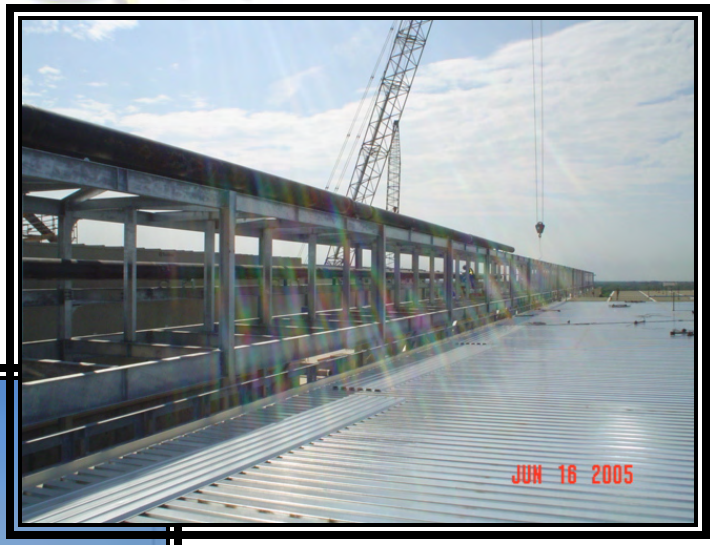
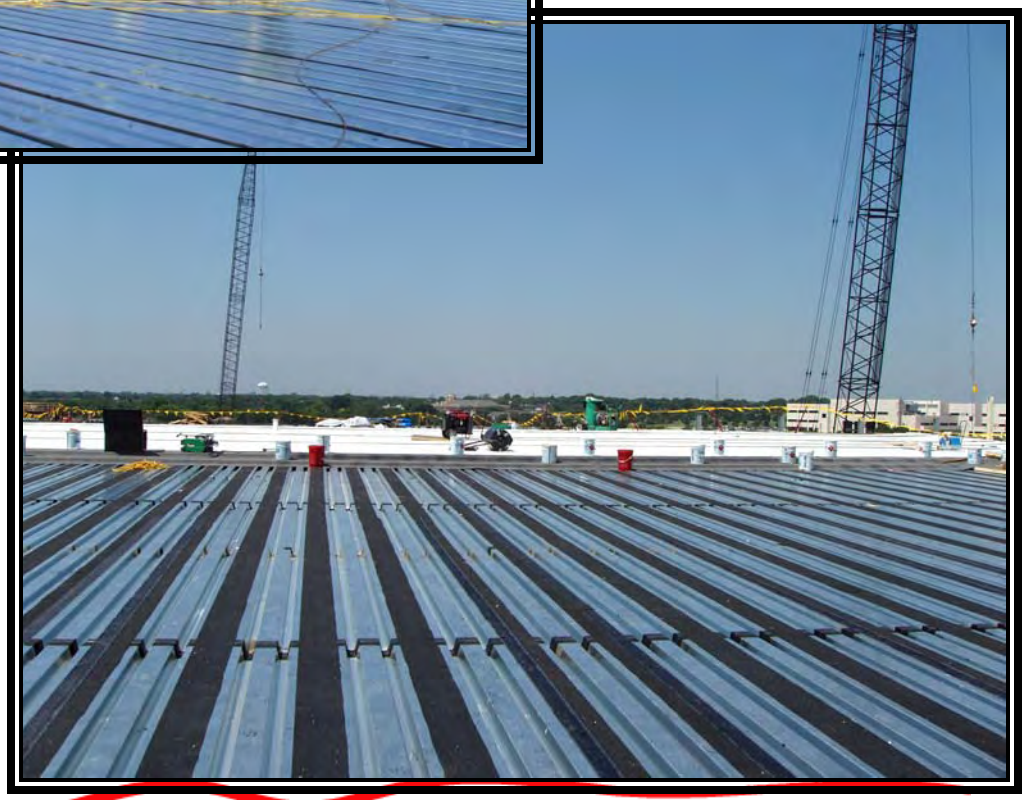


Installation of the Self-Adhering Membrane at Metal Deck End Laps, Side Laps and at Perimeter



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I Count 4 Inspectors!

Installing the Multiple Layers of Insulation

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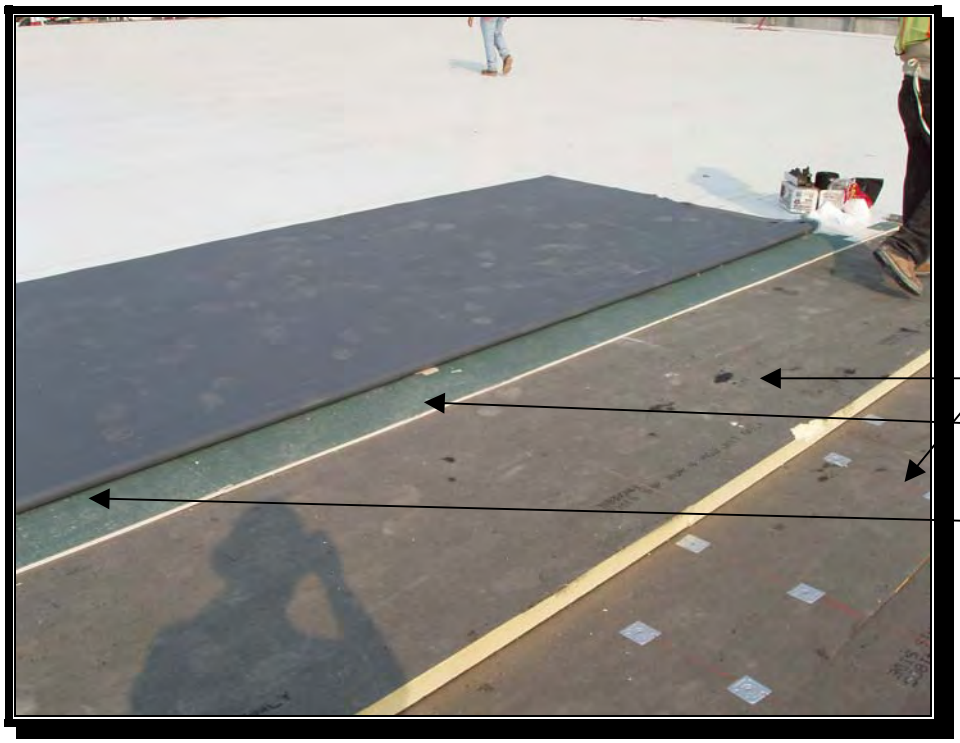

Multiple Layers of Insulation

1. **2.7”Polyisocyanuarte Mechanically Fastened**
2. **2.7”Polyisocyanuarate Olybond Adhesive.**
3. **½” DensDeck Primed Olybond Adhesive**
4. **72 mil Fully Adhered PVC**

Crew Blowing Any Dust From the Insulation Surface Prior to Installing PVC Membrane

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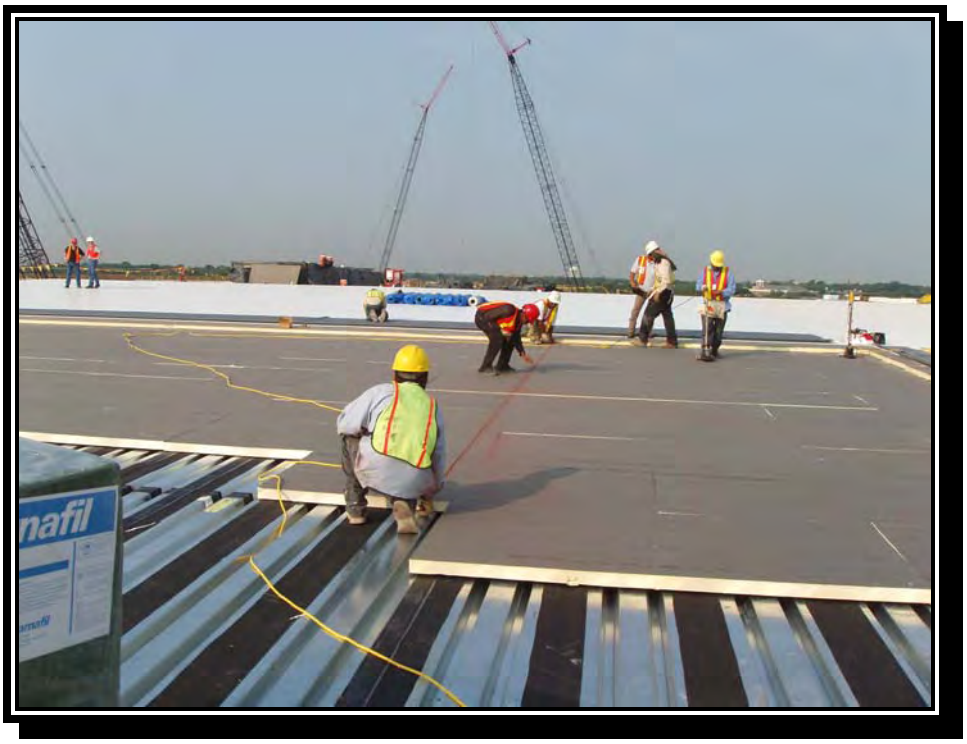
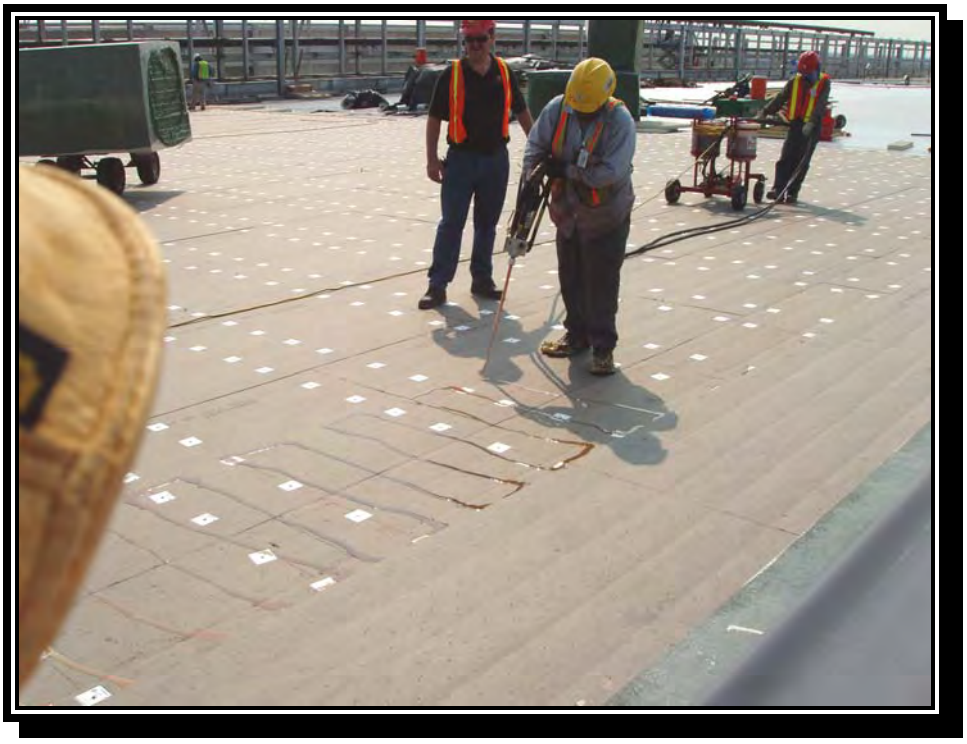


Aligning for Proper Fasteners Installation. Due to the Dust Control Environment, the Fasteners Had to Be Placed Perfectly



Crew Installing the Olybond Adhesive

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NARRATIVE

Pipes and More Pipes

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NARRATIVE

THE CHALLENGE

The Texas Instruments RFAB Building new construction facility was a challenging project, not only to estimate but also to execute. From the Energy Cap SBS Modified Bitumen membrane system to the multi layers insulation and PVC roof with dust control metal deck sealing, this project required creative solutions from planning through completion. The 250,000 square foot Fab roof is over a controlled environment clean room manufacturing area, which could not allow any microscopic contaminants entering through the roof system. All potential entry points were seal to create a total system envelope.

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A large interest is always shown in a high profile project such as The Texas Instruments RFAB Building. As the bid date approached we analyzed the various phases and the requirements set forth in the Bid Documents to properly clarify details in the scope of work to our production team to insure proper quotes. We reviewed the scope of work to analyze all the client's special requirements such as the LEED requirements, Factory Mutual requirements, the energy cap sheet and the energy star PVC membrane, a-typical insurance requirements, site restrictions, construction safety issues, environmental concerns and public safety interest. Out of the several bids that were submitted, Castro Roofing of Texas was selected from a list of candidates and awarded the project.

We knew from the beginning this project would be one of the most challenging new construction roofing projects to date. Due to the high profile of this project, the owner utilized several entities, including internal and external property management, in addition to an external roofing consultant to co-manage the construction.

SUBCONTRACTOR COORDINATION

Due to the job's multi-levels and tight schedule, there was a need for coordination between the numerous subcontractors. At times it was necessary for them to work over the newly finished roof, for which Castro Roofing provided insulation to protect the new roof.

The entire project was delayed due to shortages and schedule of steel. We worked very closely with the steel subcontractor and general contractor to maintain the original schedule. To bring the project back on schedule, we increased the crew size, which enabled the schedule to be met. In fact, we helped beat the schedule by four weeks. This allowed other subs in the interior of the building to continue on working through the delay and therefore not impact the schedule.

TECHNICAL CHALLENGES

The biggest challenge and surprise on this project was the need to seal the side and end laps of the metal deck. This requirement was not known at the time of pricing the project. Castro Roofing designed the sealing system to meet the owner's needs to have a dust control system that would not fail after years of use.

The PVC was installed over a metal deck that required all holes, punctures and defects to be sealed with self-adhering membrane and all flutes spanned to create a virtual air tight enclosure. This is also a LEED project, which meant that all application techniques had to be met very strictly with environmental and recycle standards.

The metal deck had to be perfectly sealed; Castro Roofing recommended the use of high temperature self-adhering membrane as the dust control membrane. The deck was properly prepared and cleaned prior to installing the membrane. The membrane was installed using care not to cause any voids or wrinkles on the tight corners of the metal deck.

The ice and water shield had to be inspected daily early in the morning. Castro Roofing used the interior lights of the building to inspect for any light coming from underneath the building. After multiple inspectors approved the rigorous inspection process, the multiple layers of insulation and membrane roofing were installed.

Another challenge was the special coordination necessary to produce a finished roof to meet milestones that also allowed other trades to continue their progress. Castro Roofing at times assumed the role of Production Coordinator to facilitate overall progress and not compromise the quality of the finished roof surface due to damage or abuse from other trades. The success of this project is a result of the many different trades respecting each other's craft to a degree that repairs and rework of damaged finished product was kept to a minimum.

Pipes, Penetrations and Duct Were Located Over The Modified Bituminous Membrane Roof Areas.

Coordination Between Subcontractors Was Crucial To Install The Energy Cap Sheet After Work By Others Was Completed

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Semiconductor Plant Aims for High Sustainability

(enr.construction.com - 06/12/06)

By William J. Angelo

A new $300-million Texas Instruments Inc. semiconductor fabrication plant now nearing completion in Richardson, Texas, is going for the green, gold and silver. The green is an estimated $4 million in annual energy savings flowing primarily from an innovative HVAC system. Gold and silver may be Leadership in Energy and Environmental Design certifications for its office building and groundbreaking plant, respectively.

Savings. A Texas Instruments wafer plant in Texas could become a green trendsetter.

The 1.1-million-sq-ft fabrication plant, called 'RFAB', is part of Dallas-based TI's sustainable building drive. "This building wraps all our best green practices with some new ideas for a whole system of sustainable design," says Paul R. Westbrook, TI sustainability manager. "We had thought of building overseas but stayed after state and local property tax abatements totaling $295 million over 24 years were granted and the state gave $300 million in support to the University of Texas at Dallas, School of Engineering, which is important for our access to top-tier research."

Big Thirst. New fab plant will reduce water consumption by a third in a drought area.

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Once the decision was made to stay in Texas, TI went into a year-long planning mode. “They wanted to size it right and keep the price competitive with an overseas operation,” says Jim Carr, project manager for Austin-based CH2M Hill IDC, which performed process and clean room engineering as part of a design-build team led by Austin Commercial LP, Dallas. “We implemented design objectives without oversizing, which is a break with tradition because these firms usually build for the next generation,” he says.

Architectural work was performed by PageSoutherlandPage, Dallas, and structural engineering by Paragon Structural Design Inc., Phoenix. TI specifically requested that the project be certified under the LEED program, with a three-to-four-year payback.

When operational next year, the plant will produce thousands of chips on 300- mm-dia silicon wafers for use in cell phones and other electronic devices. “Because of global competition, particularly from China, we were asked to bring the project on line under $500 million and in 14 months,” says Steve B. Penson, Austin project executive. “It had to be $200 million cheaper than a comparable facility we did in Dallas in 1996 so we needed to lower initial building and operating costs. We reengineered the facility and implemented a new HVAC system.” According to Westbrook, RFAB came in 30% less per sq ft than the old facility.

The new, fast-tracked facility has 225,000 sq ft of office space, a 150,000-sq-ft support building, an 80,000-sq-ft central plant and a 645,000-sq-ft fabrication building with a 220,000-sq-ft clean room. TI awarded Austin the contract in late 2004 and the project now is substantially complete. With equipment, the plant will cost a total of $3 billion.

“We were worried about the silver certification because fab plants are by nature huge energy hogs,” says Michael J. McCoy, PageSoutherlandPage vice president. An efficient heat-recovery system eliminates four of six boilers. “We used two different electrically controlled temperature chilled-water systems, 40°F and 54°F, a split chiller plant, and the waste heat off the 54° system was used to generate hot water for the plant,” says Penson. “Domestic hot water comes from four solar energy panels.” Other touches include a reflective roof, natural daylighting and smart light fixtures.

The green systems cost an additional $1.5 million but should pay for themselves in under

two years. “Saving energy in one type of building is like saving energy in any other type,” says Westbrook. “It all comes down to good design. In this case, we made design decisions when electricity was less than .05 cents per kilowatt hour, and it is much higher now.”

As part of the green process, construction waste also was recycled, with only 10% going to landfill. “That is very unusual,” says Penson. “Typically you would see over 50%.”

A deionized water treatment plant will recapture and recycle water used in production, eliminating 35% of municipal water purchases. That is critical since Texas has been suffering from drought conditions. “Normally, we use about 3 million gallons per day,” says Westbrook. “With this system, we reduce that need by 1 mgd.”

Although the paperwork for LEED certification has not yet been completed, “we have a high level of confidence that we have generated sufficient points for gold and silver certification,” says Penson. “When they get it, RFAB will become the largest facility and the first wafer fab to receive a LEED designation.”

Images courtesy of PageSoutherlandPage LLP) and text by The McGraw-Hill Companies

SAFETY

Safety Is Everywhere

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SAFETY

SAFETY: THERE IS NO COMPROMISE!

When it comes to safety at Castro Roofing of Texas, L.P. there is no compromise! Castro Roofing's Safety Performance record was very impressive and in most areas met or exceeded the standards as set by the Owner. This fact was a major reason fro the project award as stated by Austin Commercial.

Because our crews consist of 100% Hispanic workers, we provide for better comprehension all "Tool Box Talks" in Spanish. Below is a sample translation of a few accident prevention talks:

- Scaffolding
- Hand Tools
- Flammable Liquids and Combustibles
- Eye Protection
- Protective Wear (Gloves, Clothes and Shoes)
- Hard Hat
- Fire Safety Watch
- Operating the Kettle
- Back Injury Prevention
- Heat Exhaustion
- Practical Jokes on the Job Site

Hard Hat, Roof Protection and Scaffolding Use Per OSHA Regulations

NO INJURIES!

While construction was underway, Castro Roofing of Texas, L.P.'s safety personnel kept a close eye over the entire project team. Because Castro's team was working over curved standing seam step-slope roof and low slope-roof hot applied SBS modified roofing system, constant safety meetings and inspections were performed.

Castro Roofing of Texas, L.P. is extremely proud to announce that no accidents and no lost days were experienced on the Texas Instruments RFAB Building!

100% Tie-Off!

TESTIMONIALS

Forest of Cranes

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Austin Commercial
An Austin Industries Company

Construction Manager/General Contractor
1501 South Mopac, Suite 210
Austin, Texas 78746

December 27, 2006

To: Rudy Rodriquez

From: Rolando Zarate Jr.
Austin Commercial Superintendent
972-989-3829

Subject: Letter of Reference for the RFAB TI Project
Richardson, TX

Dear Rudy,

On behalf of Austin Commercial and myself, congratulations for a job well done at TI. Castro Roofing met all milestone dates confronted by numerous changes, a demanding schedule, and weather. Please take this letter as being recommended highly on any future projects. I would also like to complement Jimmy Scott for the difficult challenge of installing the built up roofing around the air handling units, the cooling tower, and acid/scrubber roof areas.

Sincerely yours,

Rolando Zarate Jr.

Rolando Zarate Jr

McINTARE & ASSOCIATES INC.
PO Box 1077 - Granbury, TX 76048-8077 - **Fax**: (817) 279-1223
Don McIntare, V.P/E.O - Cell: (817) 680 - 4332 - Email: Dmcintare@aol.com

Date: 11/29/06

Attn: TO WHOM IT MAY CONCERN

Re: NEW FAB ROOFING PROJECT
TEXAS INSTRUMENTS, RICHARDSON TEXAS

Castro Roofing of Texas 4854 Olson Drive, Dallas Texas 75227 installed both new Modified Bitumen and Thermoplastic (PVC) Roofs on the above-mentioned facility.

There were numerous scheduling and detail problems that worked out to keep the project on time and with-in budget.

It was a pleasure to have the opportunity to work with Castor roofing on such a large and fast paced project.

Don McIntare

McIntare and Associates, Inc.
P.O. Box 1077
Granbury, TX. 76048
Phone# 817-680-4332
Fax 817-279-1223
e-mail dmcintare@aol.com

Sarnafil Inc., (Southwest Region) 3727 Greenbriar, Suite 404, Stafford, Texas 77477
Phone: 281-325-0182 Fax : 281-325-0185
Email: webmaster@sarnafilus.com

December 8, 2006

Rudy Rodriguez
Castro Roofing of Texas, Inc.
4854 Olson Drive
Dallas, TX 75227

RE: Texas Instruments Semiconductor Fabrication Plant, Richardson, Texas

Dear Mr. Rodriguez:

On November 18, 2004, Texas Instruments broke ground to build a LEED certified semiconductor manufacturing complex in Richardson, Texas. The construction of this project was going to be fast-tracked. The facility has over 225,000 sq ft of office space, a 150,000-sq-ft support building, an 80,000-sq-ft central plant and a 645,000-sq-ft fabrication building with a 220,000-sq-ft clean room. This facility is the first in the electronics industry to include a production development center, equipment evaluation center and a manufacturing plant under one roof.

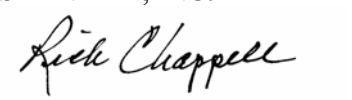
Your company was selected by Austin Commerical to installed the Sarnafil Adhered Roofing System over the clean roof portion of the facility – a 220,000 square foot roof area. The roof had to be installed in a such a matter not only to meet the LEED Silver certification requirements, but also meeting the clean roof requirements of having the roof insulation attachments to align in a special matter – all in straight rows and hitting the top of the steel decking flutes. The onsite owner's representative expected the completed roofing system not to have any wrinkles in the field sheet or in the seams of the membrane. Add to the challenges of the project, the roofing began in March, 2005 and had to be completed in short time period.

The project was not always easy, your roofing crews had adnormal March winds and below normal tempertures to deal with during the course of installing the adhered system. Your roofing crews were creativity in working these conditions by planning and origanizing the work with the daily weather conditions. At the end of the project, the Sarnafil membranes seams and field sheet were picture perfect. The owner representative was pleased with the aesthetics of the roof.

I am proud of your accomplishments at this project, which was rated Number One for Outstanding Projects in 2004 and 2005 for Texas new construction projects. It is one project you should also be proud of knowing your roofing crews have developed an image for your company of being dependable, proficient, and possess exceptional workmanship quality in the roofing industry. As I tell architects and owners, "we have one of the best single plies available on the market, but we are not no better than the roofing contractor that installs our roofing membranes." This will be one project we can reflect over the years and know we have a roofing system that will perform for over 20 years due to the quality of your workmanship.

Thank you for the exceptional work for this project!

Sincerely,
SARNAFIL, INC.



Rick Chappell
Southwest Region Manager

GAF MATERIALS CORPORATION

GAF MATERIALS CORPORATION
1361 Alps Road Wayne, NJ 07470-3689 *Telephone: 973-628-3000*

December 7, 2006

Rudy Rodriguez
Castro Roofing of Texas, LP
4854 Olson Drive
Dallas, TX 75227

RE: Texas Instruments R FAB Building – Plano, Texas

Rudy,

We just wanted to take a moment to congratulate Castro Roofing for a job well done on the Texas Instruments R FAB Project. Castro Roofing has been GAF Master Contractor since 1996 and we appreciate the opportunity to continue working with you on projects like this.

Both Castro Roofing and GAF strive to be the property owners' "best and safest choice" when it comes to roofing and this project is a good example of that dedication to customer satisfaction. Your Team has installed a GAF Ruberoid *EnergyCap*™ System on this project which provides the property owner with significant benefits.

Project Information:

- *Energy Efficiency… Ruberoid EnergyCap*™ 30 FR an energy saving SBS Modified roof membrane, with emittace and reflectance ratings that exceed Energy Star requirements. The roofing membrane not only protects the facility, but also reduces temperatures on the roof surface and building interior, which results in reduced cooling costs for building owners and demonstrates environmental responsibility by helping to reduce "urban heat island" related issues
- *Installation Excellence…* GAF issues a 20 year Diamond Pledge Guarantee to cover this 2,500 square project – giving the property owner "peace of mind". Castro's dedication to quality on this installation resulted in a Quality Assurance rating of 10 out of a possible 10 on the inspection that is a required element in the GAF Guarantee process.
- *System Redundancy…* a multiply system (spec I-3-1-30FR (EC)) with the highly reflective *EnergyCap*™ MB was specified and installed as a safer solution for meeting ENERGY STAR® requirements and to provide the ultimate protection for this facility.

We are proud of our association with Castro Roofing and look forward to working with you on many more roofing projects.

Very truly yours,

Mike DiStefano
Director of Marketing
GAF Materials Corporation

AERIAL/PROJECT PHOTOS

Bird's Eye View

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AERIAL PHOTOS

January 2005

The trailer park was nearly completed, and foundation piers were installed. Above ground concrete pours continued along with topsoil removal.

February 2005

Foundation piers construction was initiated with an expected completion date set for the end of February. Fabrication of structural steel, exterior pre-cast concrete skin and switchgear were scheduled to be finished in late March.

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March 2005

The Blue Color On The Ground Are the Covered Roofing Materials for the FAB Building Constructions of the buildings' deep foundations were completed. Underground utility work was expected to continue for several more weeks. The erection of structural steel and site paving began and major earthwork was completed.

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April 2005

All building subgrade and foundation piers were completed, while elevated structural steel construction began. Forest of Cranes

May 2005

All foundation piers were completed. Installation of structural concrete and steel erection continued. Painting of manufacturing floors was ongoing, along with installation of interior walls.

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June 2005

PVC Roof Installed Over The FAB Building (White Membrane)

Self-Adhering Membrane Installed At End Laps & Sides Laps of Metal Deck Prior To Installing Roof System (Black Surface)

July 2006

PVC Roof Installed Over The FAB Building (White Membrane)

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August 2005

PVC Roof Installed Over The FAB Building (White Membrane)

TI officially "topped out" the building this month to celebrate the completion of the building's structural steel and concrete. Roofing, window walls and precast erection continued around the exterior skin of the facility, while interior structural steel pipe racks were being installed.

February 2006

Modified Bitumen Energy Cap Sheet (all roofs completed)

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February 2006
Modified Bitumen Energy Cap Sheet (all roofs completed)

February 2006
PVC Roof Installed Over The FAB Building (White Membrane)
Modified Bitumen Energy Cap Sheet
(all roofs completed)

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CASTRO
ROOFING OF TEXAS

PROJECT PHOTOS

Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Star PVC Roof

Energy Star PVC Roof

Energy Star PVC Roof

Energy Star PVC Roof

Energy Star PVC Roof

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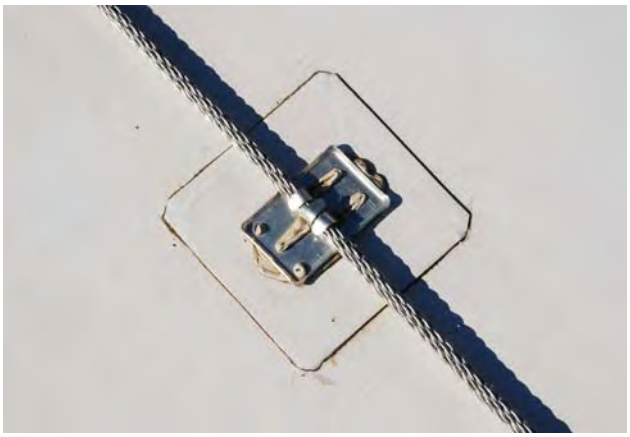

Energy Star PVC Roof

Energy Star PVC Roof

Energy Star PVC Roof

Energy Cap Modified Roof

Energy Star PVC Roof

Energy Star PVC Roof

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Energy Cap Modified Roof

Energy Star PVC Roof

Energy Cap Sheet Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

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Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

Energy Cap Modified Roof

Parapet Joint Seal

Energy Cap Modified Roof

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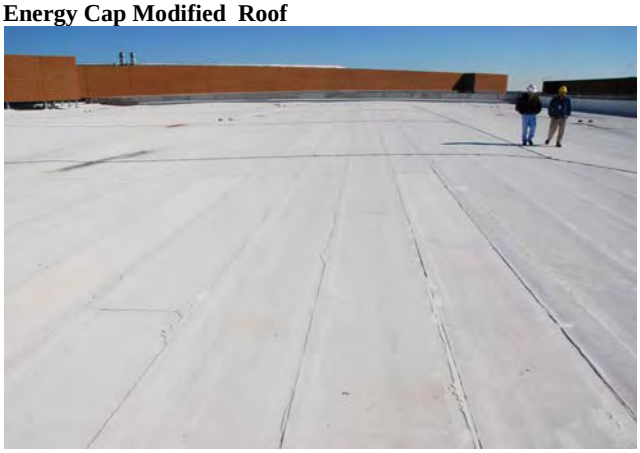
Energy Cap Modified Roof

Energy Cap Modified Roof



Energy Cap Modified Roof

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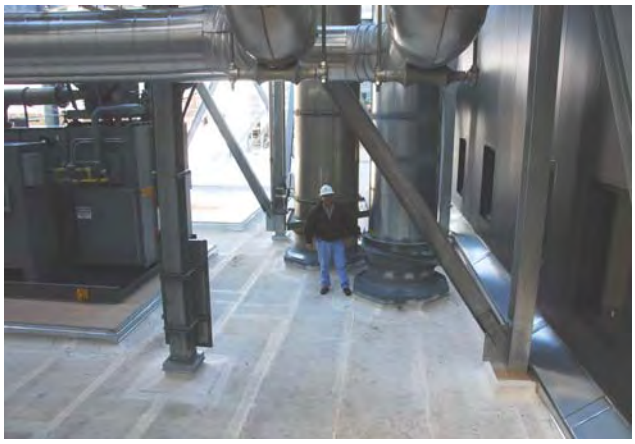

Energy Cap Modified Roof

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Energy Cap Modified Roof

Energy Cap Modified Roof

East Side of Fab Building

East Side of Fab Building

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MEMBERS

"Team Work"

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CASTRO
ROOFING OF TEXAS

NTRCA MEMBER INVOLVEMENT

This project was self-performed by Castro Roofing of Texas, L.P. with its own forces.

Under Castro Roofing of Texas, L.P. contractor's scope of work, the following NTRCA members contributed to the success of this project:

- GAF
- SARNAFIL
- DALLAS/FORT WORTH ROOFING SUPPLY

Olybond Adhesive Over 1st Layer of Mechanically Fastened Insulation

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MISCELLANEOUS

Energy Cap Sheet Roof Areas with Multiple Penetrations and 35 Foot Wall At The Perimeter.

LEED Certified Roof Systems.
PVC & Modified Energy Cap Sheet

Three Different Roof Levels With Various Roof Top Units and Pipes

PVC Roof With 3-Layers of Roof Insulation and 800'Of Internal Roof Gutter w/Roof Drains

The Making of RFAB

In June 2003, Texas Instruments announced it had selected a site for its next major semiconductor manufacturing plant: the corner of Renner and Alma Roads in Richardson, Texas, just north of TI's headquarters in Dallas. The site selection for the proposed plant was the first important step toward expanding the company's worldwide manufacturing capabilities. TI looked at several locations around the globe to build, but selected Texas for several reasons.

One was the "home court" advantage and close proximity to TI's existing facilities in Dallas. But not to be overlooked was the promise of top-notch university research and the availability of a talented workforce, made possible through a collaborative agreement between state and local government entities and the University of Texas system. The agreement will promote the North Texas region's technological future by boosting funding for engineering and research programs at the University of Texas at Dallas.

Soon after the site was identified, TI embarked on an ambitious project to design the future plant in a manner that would reduce operating costs and environmental impact. After collaboration with the Rocky Mountain Institute, months of research, careful planning and innovative design, the tremendous project came to fruition. RFAB is now set to be the world's first "green," LEED-certified (Leadership in Energy and Environmental Design) semiconductor manufacturing facility and the largest certified building in the North Texas region.

Quick Facts*

• Cost to build to date	~$300M
• Minority-owned suppliers expenditures	25% of cost to build
• Texas funding for local engineering education	$300M
• Investment in "green" building	$<2M
• Clean room size (bigger than four football fields)	220,000 square feet
• Complex total size	1.1M square feet
• Concrete used	Equivalent to 14 miles of road
• Steel used	Equivalent to 4,000 recycled cars
• Electrical wire installed	Enough to stretch from Dallas to Oklahoma City

*Estimated

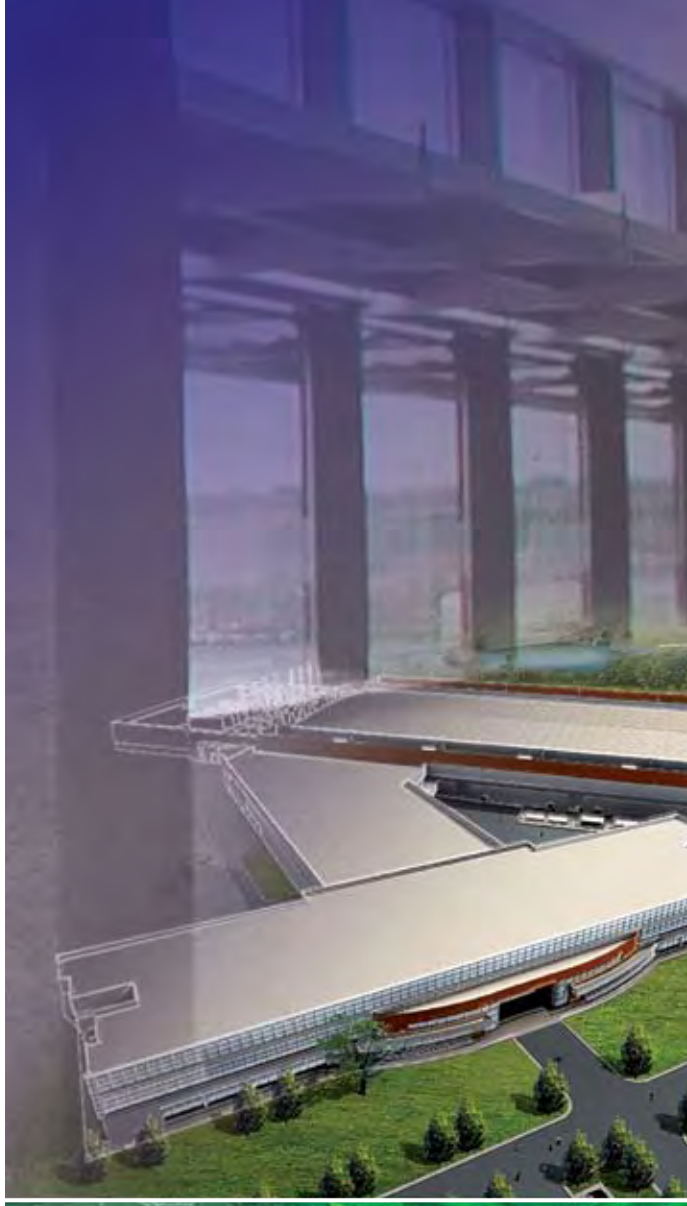
Benefits of Sustainable Design

- Efficiency gains of about $1 million in the first year
- Annual efficiency savings greater than $4 million per year when fully operational
- Water savings of 35% and energy savings greater than 20% of a traditional fab
- Use of natural daylight, eliminating the equivalent of 26 tennis courts worth of indoor lighting
- Waste fly ash used in construction displaced enough concrete to build three miles of road
- Enough reclaimed and recycled water to fill a large water tower
- Enough electrical savings to power 2000 homes and natural gas to supply 500 homes
- Enabled 90% of construction waste to be recycled
- Elimination of 80% of the natural gas boiler use resulting in significant reductions in air emissions and related operational costs through the use of heat recovery from air compressors and chillers

Texas Instruments

Printed on recycled paper with soy-based inks.
Printed in the USA.

Texas Instruments



RFAB

TI's Richardson Fab

Welcome to RFAB, which stands for Richardson Fabrication, the latest state-of-the-art manufacturing facility of Texas Instruments. When operational, the fab will produce sophisticated semiconductors, the brains inside a vast array of electronics such as digital cameras, cell phones and other devices. Beyond the cutting edge products it will manufacture and the leading technology it will use, RFAB stands in a class of its own. The site's innovative and high-efficiency design, the first of its kind in the world, enables the company to operate at a lower cost and with reduced environmental impact.

Facts about the facility

- The building is 1.1 million square feet of space on 92 acres of land and includes administration, mechanical, support and fabrication buildings.
- When fully operational, the fab will house about 1,000 engineers, technicians and administrators.
- The fab will produce chips on 300 mm wafers, which are 12 inches in diameter.
- The fab is an ISO Class 5 clean room, meaning it is 1,000 times more pure than the normal hospital operating room. For example, the average room has between 300,000 and 1,000,0000 particles per cubic foot. TI's clean room will have about 100 particles per cubic foot.
- Total cost of the construction was ~$300 million. Of that amount, 26% was spent with minority-owned businesses and more than 15% with women-owned businesses.
- As part of TI's agreement to keep the facility in Texas, the University of Texas at Dallas is receiving $300 million in order to improve the school's engineering program. The goal of UTD is to be among the best 50 engineering programs in the U.S. in five years. Engineering talent and research are necessities if the United States expects to continue to be the technology leader.
- According to a report from economist Ray Perryman, when RFAB's phase-one development is complete, the facility's operation will contribute $13.2 billion in total expenditures, a gross product of $7.1 billion and generate more than 82,400 permanent jobs in the local economy.
- The building was designed with particular attention to decreasing its environmental impact. TI engineers spent time with experts from the Rocky Mountain Institute to create an extremely efficient, "green" complex, unlike any other semiconductor facility in the world.
- During construction, TI recycled more than 90% of waste and made extensive use of recycled materials.

Some more notable features of the building's "green" design include:

- An onsite retention pond to collect rain that can be used for irrigation and also eliminates storm run off
- Native prairie grassland and vegetation that require little or no water and maintenance to thrive
- Reflective roofing and concrete to reduce Urban Heat Island Effect
- Waterless urinals, saving about 40,000 gallons per year per unit
- Faucets with sensors that are recharged by a small water turbine
- Light shelves to utilize natural daylight instead of fluorescents inside office areas
- Windmill-powered pond aerator
- Smart, networked lighting with built-in light and motion sensors
- Demand-controlled ventilation
- Solar water heater for administrative areas

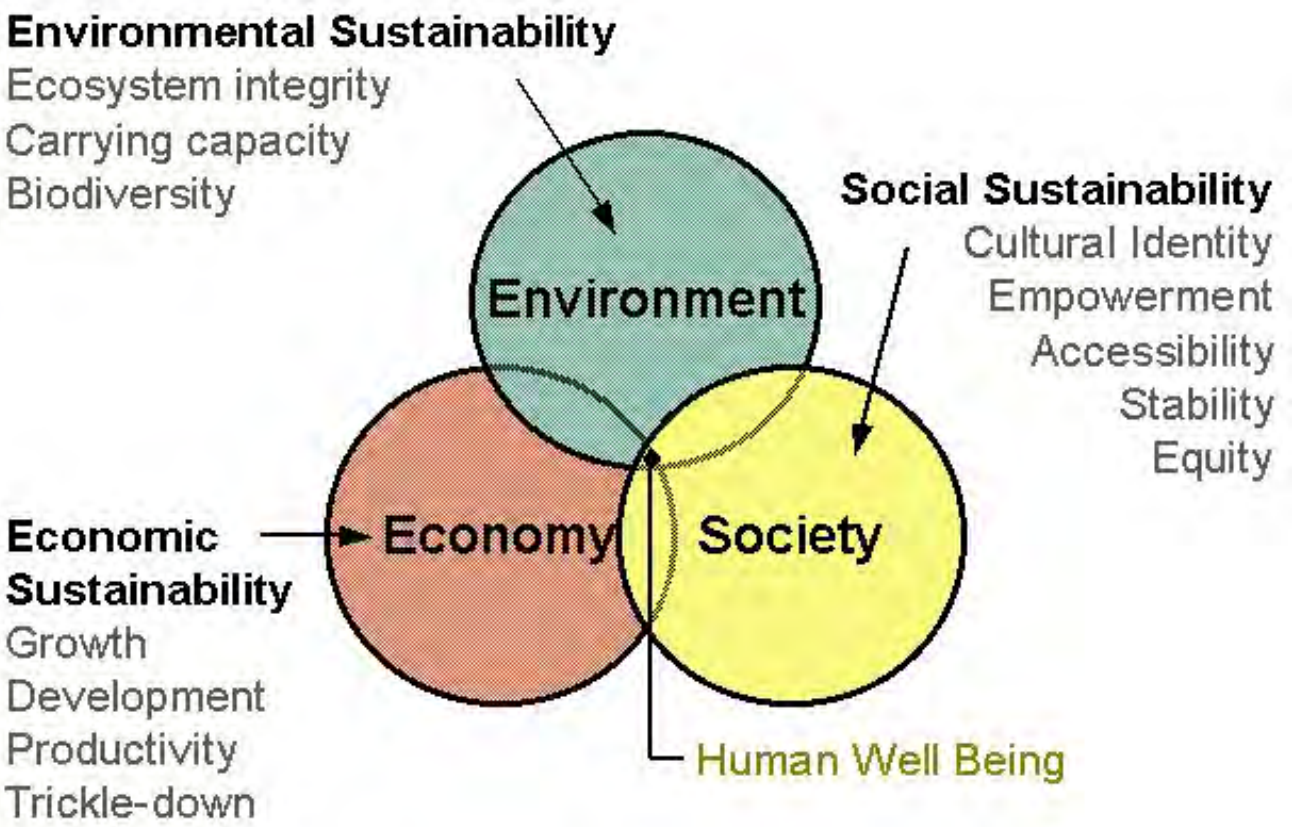
For more information, see our web site at www.ti.com/rfab or contact tilistens@ti.com.

Sustainable Wafer Fab

Paul Westbrook
Sustainable Development Manager
Texas Instruments

What is Sustainable Development?

The Balance of People, Profit, and the Planet

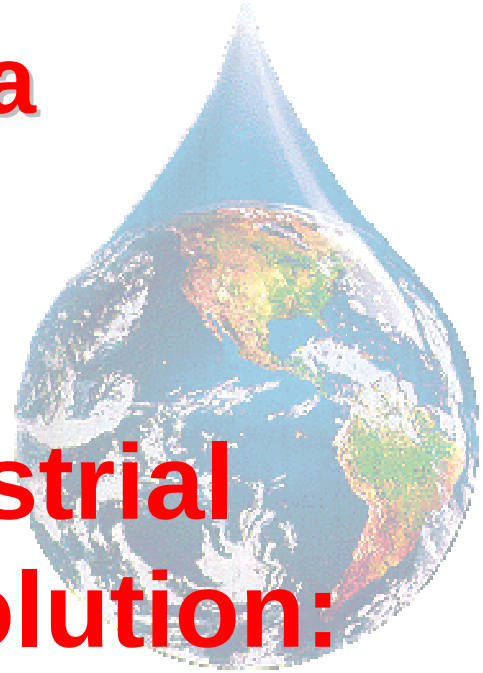


A sustainable system delivers services without exhausting resources. It uses all resources efficiently both in an environmental and economic sense.

Revolutionary Idea

First Industrial Revolution:

People are scarce and nature is abundant – increase labor productivity



Next Industrial Revolution:

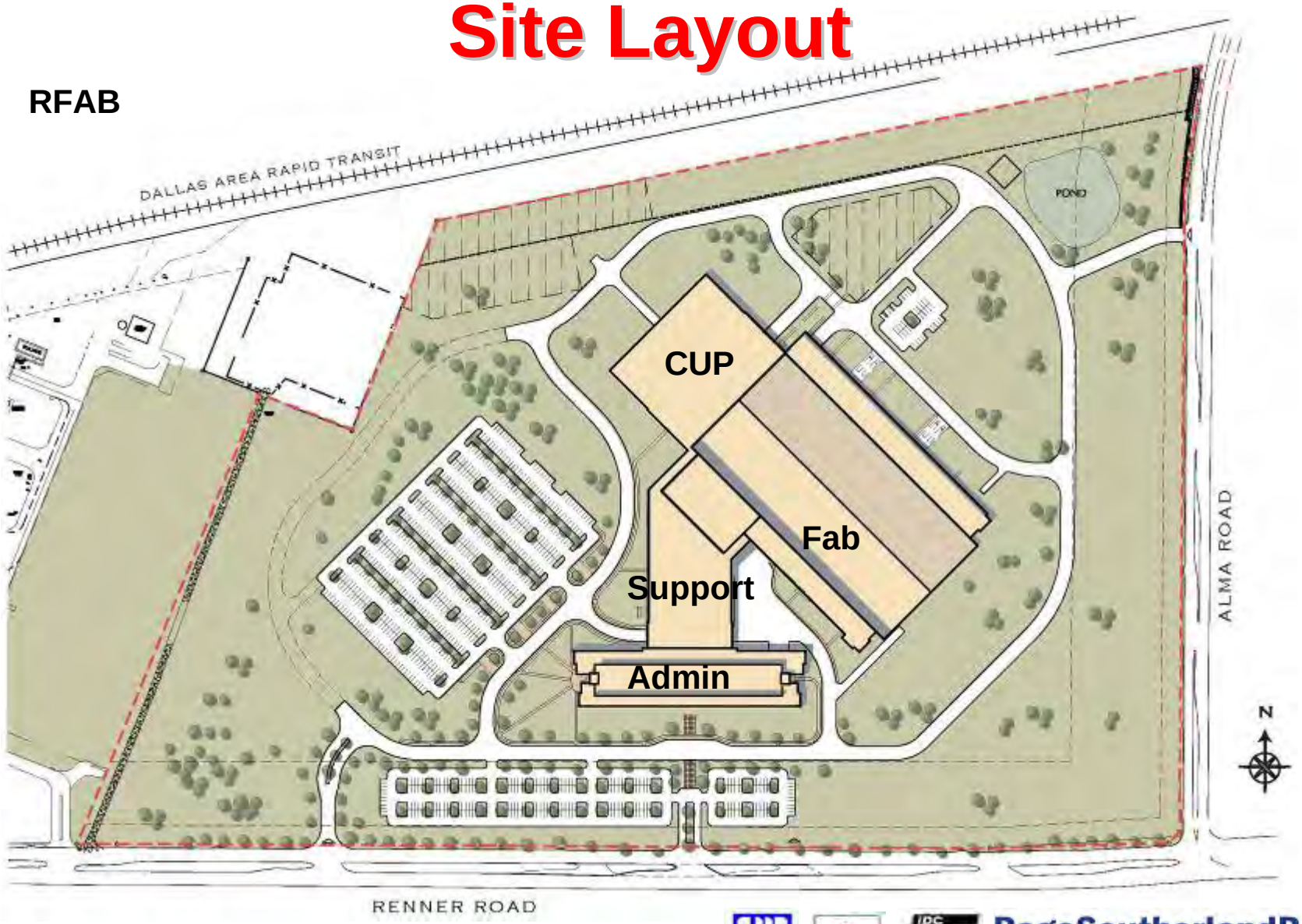
People are abundant and nature is scarce – increase **resource** productivity

TI RFAB Project Features

- 92 Acre Site
- 1,090,000 Gross Square Feet
- 220,000 Square Feet of Cleanroom Space
- Population of approximately 1000 Employees
- Main Components
  - Fab Building
  - Support Building
  - Mechanical Building
  - Administration Building

Site Layout

RFAB



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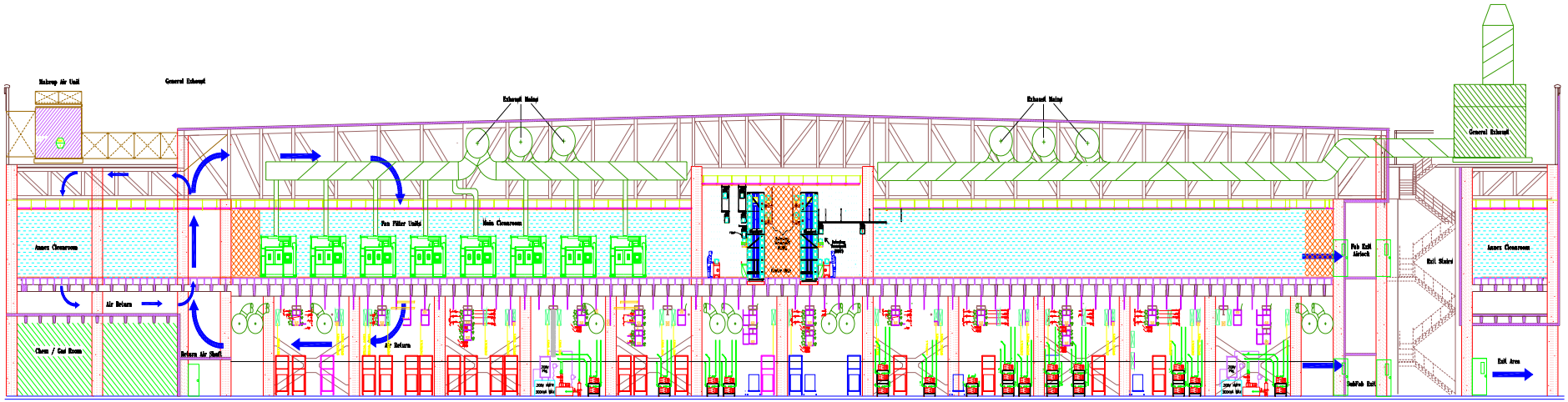
The Next 100

The Cleanroom in Section



TI Path to Sustainability

- Strategy Team - Fabscape
  - 4 strategy teams were formed in advance of project
  - Request made to add a 5th team - sustainability
  - Generated early white papers on a number of ideas
- Tour
  - Invited 3 VP's to tour active/passive solar home
  - Low utility bills for "normal" house spurred interest
- Design Charrette
  - Teamed up with Rocky Mountain Institute (RMI)
  - Held 3-day design Charrette to brainstorm ideas
  - Generated 12 "Big Honkin' Ideas" to carry forward along with a large list of other good ideas
  - Made a first pass at LEED score sheet

What is LEED?

- The **LEED** (**L**eadership in **E**nergy and **E**nvironmental **D**esign) Green Building Rating System™ is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. There are 5 broad categories that force an emphasis on a holistic approach to design:
  - Sustainable Sites
  - Water Efficiency
  - Energy & Atmosphere
  - Materials & Resources
  - Indoor Environmental Quality

Charrette - Interesting Outcome

- **First Industrial Revolution**
  - People are scarce and nature is abundant – increase labor productivity

Negawatts

Big Pipes, Small Pumps

Capital Cost Trading

- **Next Industrial Revolution**
  - Nature is scarce and people are abundant – increase resource productivity

Natural Capitalism

Resource Productivity

Q. What Did People Really Focus On?

A. How many LEED points can we get?

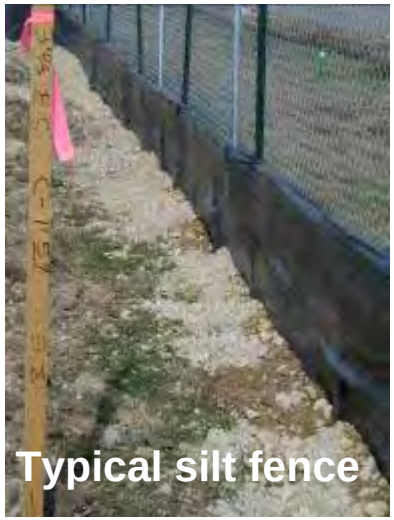
- The competitive nature of people is a strong force and can be harnessed for good. We like to save energy and reduce emissions – we love it when we score a point for doing so.

Cost Reduction – Friend or Foe?

- The design team was challenged with reducing the fab cost/sf by 30% from the previous fab!
  - Forced space efficiency (2 level vs. 3 level)
  - Forced us to question everything
  - Couldn't just copy previous design – had to innovate
  - All of this led to . . . . Engineering!
- Project was registered with **LEED**
  - Goals: **GOLD** for Admin and **SILVER** for Fab
    - 69 possible LEED points - **Certified = 26;**
      Silver = 33; Gold = 39; Platinum = 52
  - Provided a focusing mechanism for team

Sustainable Sites

☑ SS Prerequisite 1 Erosion and Sedimentation Control



Used compost filled tubes instead of typical silt fence

- ✘ SS Credit 1 - Site Selection – *lost by developing farmland*
- ✘ SS Credit 2 - Urban Redevelopment
- ✘ SS Credit 3 - Brownfield Redevelopment
- ☑ SS Credit 4.1 - Alt Trans, Public Transportation Access

  Free shuttle to rail station 1 mile away. Free annual public transportation pass for all TI employees.

Sustainable Sites

☑ SS Credit 4.2 - Alt Trans, Bicycle Storage & Changing



Provided covered bicycle parking and showers / lockers

✘ SS Credit 4.3 - Alt Trans, Alternative Fuel Vehicles

☑ SS Credit 4.4 - Alt Transportation, Parking Capacity

☑ SS Credit 5.1 - Reduced Site Disturbance, Protect or Restore Open Space

Site was a wheat field. We will restore large sections with native grasses and wildflowers.





☑ SS Credit 5.2 Reduced Site Disturbance, Development Footprint

Sustainable Sites

- ☑ SS Credit 6.1 - Stormwater Management, Rate and Quantity
- ☑ SS Credit 6.2 - Stormwater Management, Treatment

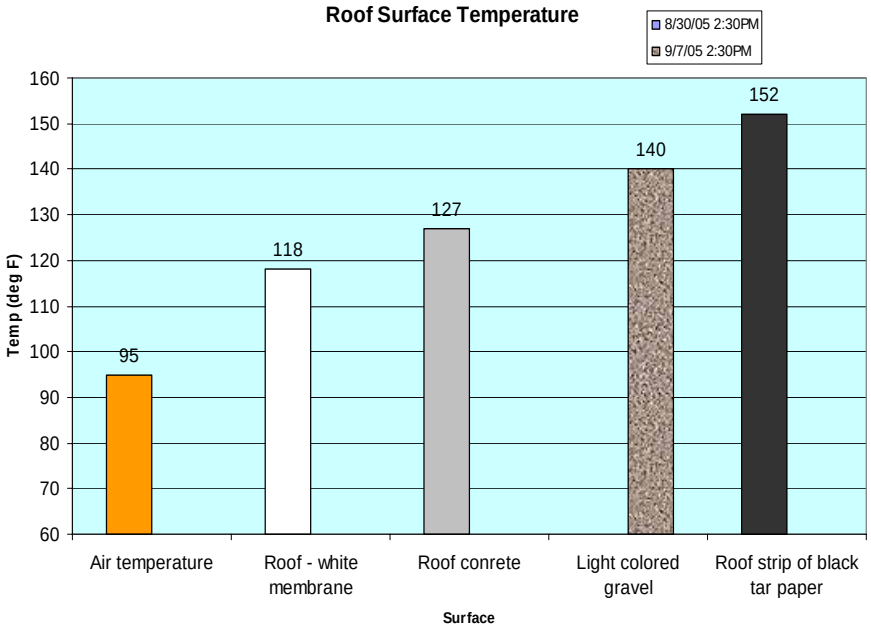
Pond collects runoff from most of the 92 acres. 2.7 million gallon base + 2 million gallon buffer. The pond meters runoff and settles sediment. Pond water is used for all site irrigation.

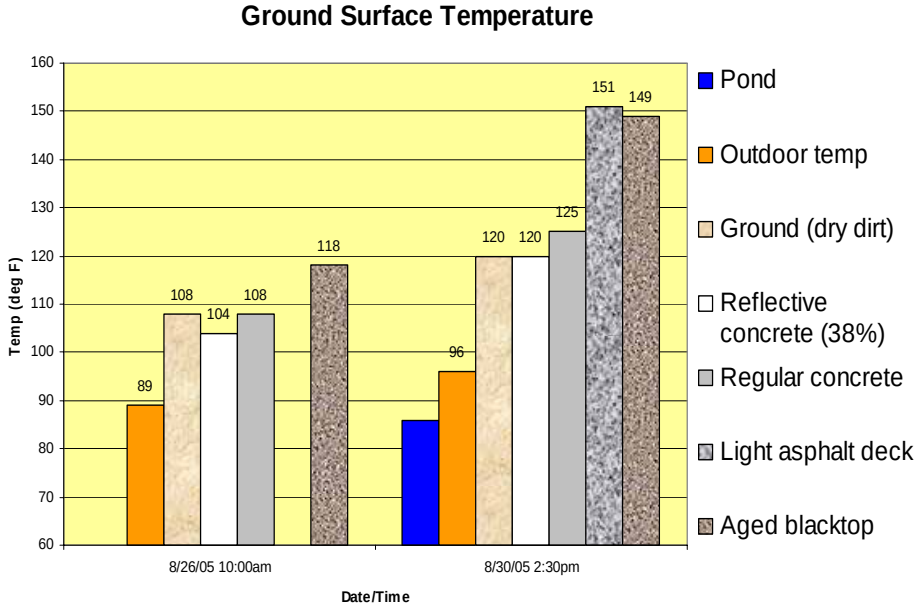
Windmill drives an air compressor to aerate the pond. >

Sustainable Sites

- ☑ SS Credit 7.1 - Landscape & Exterior Design to Reduce Heat Islands, Site – *reflective concrete, shade trees*
- ☑ SS Credit 7.2 - Landscape & Exterior Design to Reduce Heat Islands, Roof

Sustainable Sites





☑ SS Credit 8 - Light Pollution Reduction

Full cutoff down light

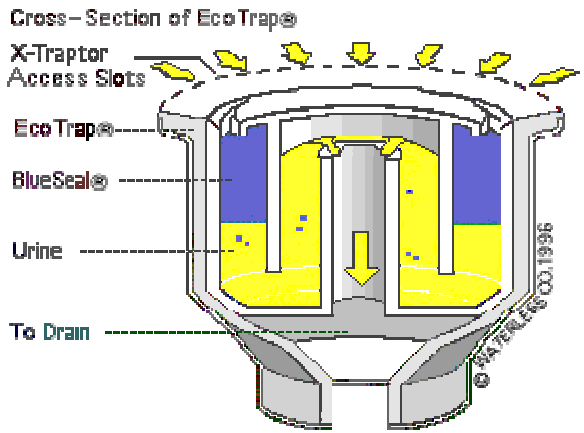
Down light for flag

Bollard – L.E.D. light, solar powere

Water Efficiency

- ☑ WE Credit 1.1 - Water Efficient Landscaping, Reduce by 50%
- ☑ WE Credit 1.2 - Water Efficient Landscaping, No Potable Use or No Irrigation – *Pond is our irrigation source*
- ☑ WE Credit 2 - Innovative Wastewater Technologies
- ☑ WE Credit 3.1 - Water Use Reduction, 20% Reduction
- ☑ WE Credit 3.2 - Water Use Reduction, additional 10% Reduction

Water turbine powered sensor faucet



Water Efficiency (FAB)

- Though it's not counted in LEED, there are a number of process water reclaim and reuse steps incorporated:
  - RO Brine is used in the cooling towers
  - Primary Mixed Bed Water is used for CMP polishers
  - Secondary UF for additional water recovery from UF and Polish Beds
  - Secondary rinse bath DI water reclaim
  - IW water used for POU abatement and large exhaust scrubbers
  - Segregate and collect sulfuric acid waste
  - MUA condensate sent to site pond for irrigation use

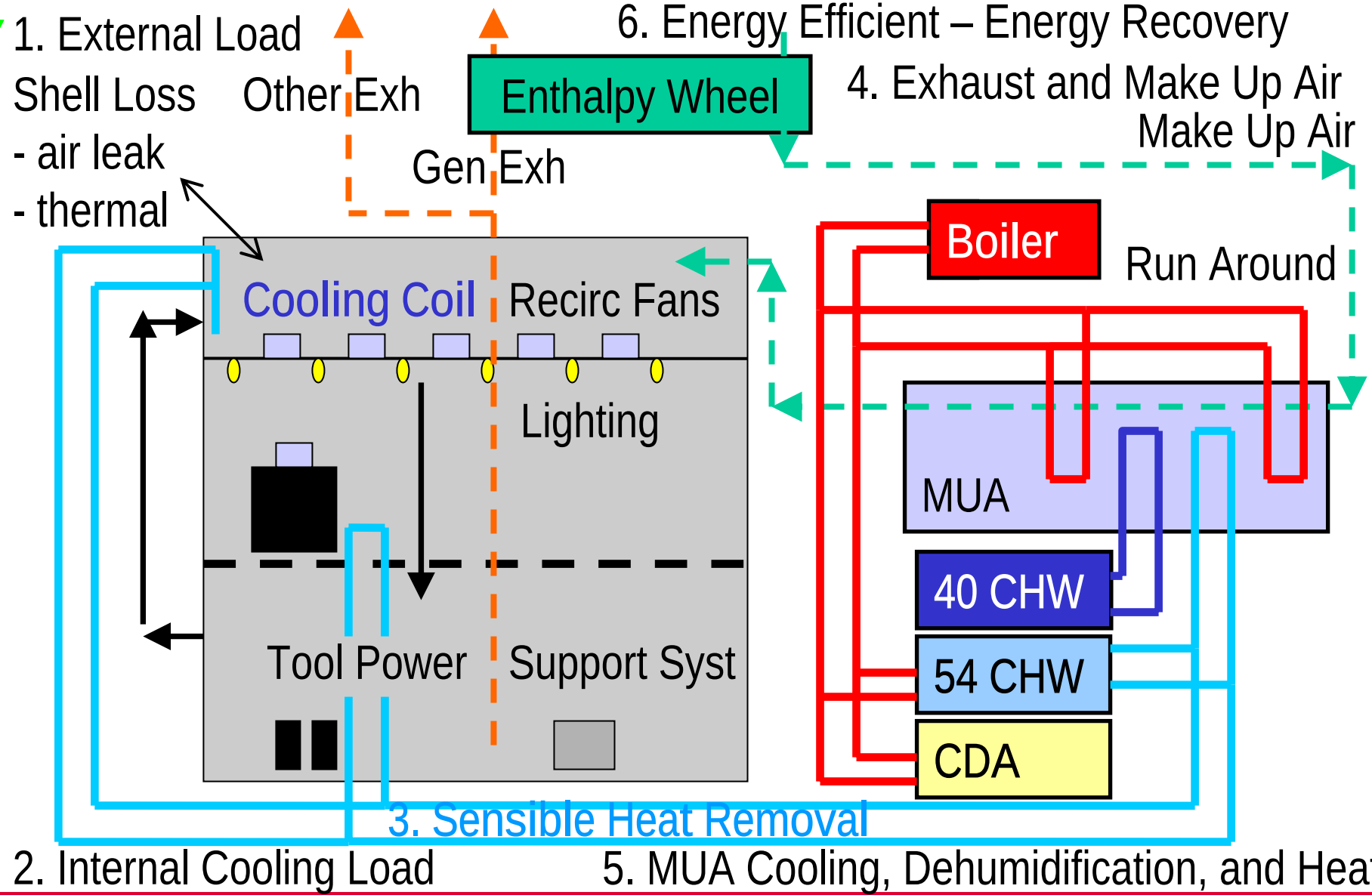
Energy and Atmosphere

- ☑ EA Prerequisite 1 Fundamental Systems Commissioning
- ☑ EA Prerequisite 2 Minimum Energy Performance
- ☑ EA Prerequisite 3 CFC Reduction in HVAC&R Equipment
- ☑ EA Credit 1.1 - Optimize Energy Performance,
  15% New, 5% Existing (above Energy Code Std)
- ❑ You earn an additional point for every 5% improvement up to a max of 10 points in this category. We expect to reach 4-6 points (~35% better than code).

ENERGY SAVINGS APPROACH

- ✓ Tools and Support Equipment
- ✓ Shell efficiency
- ✓ Facilities systems integration and efficiency

Fab Energy Flow



Energy Savings – Tool Loads

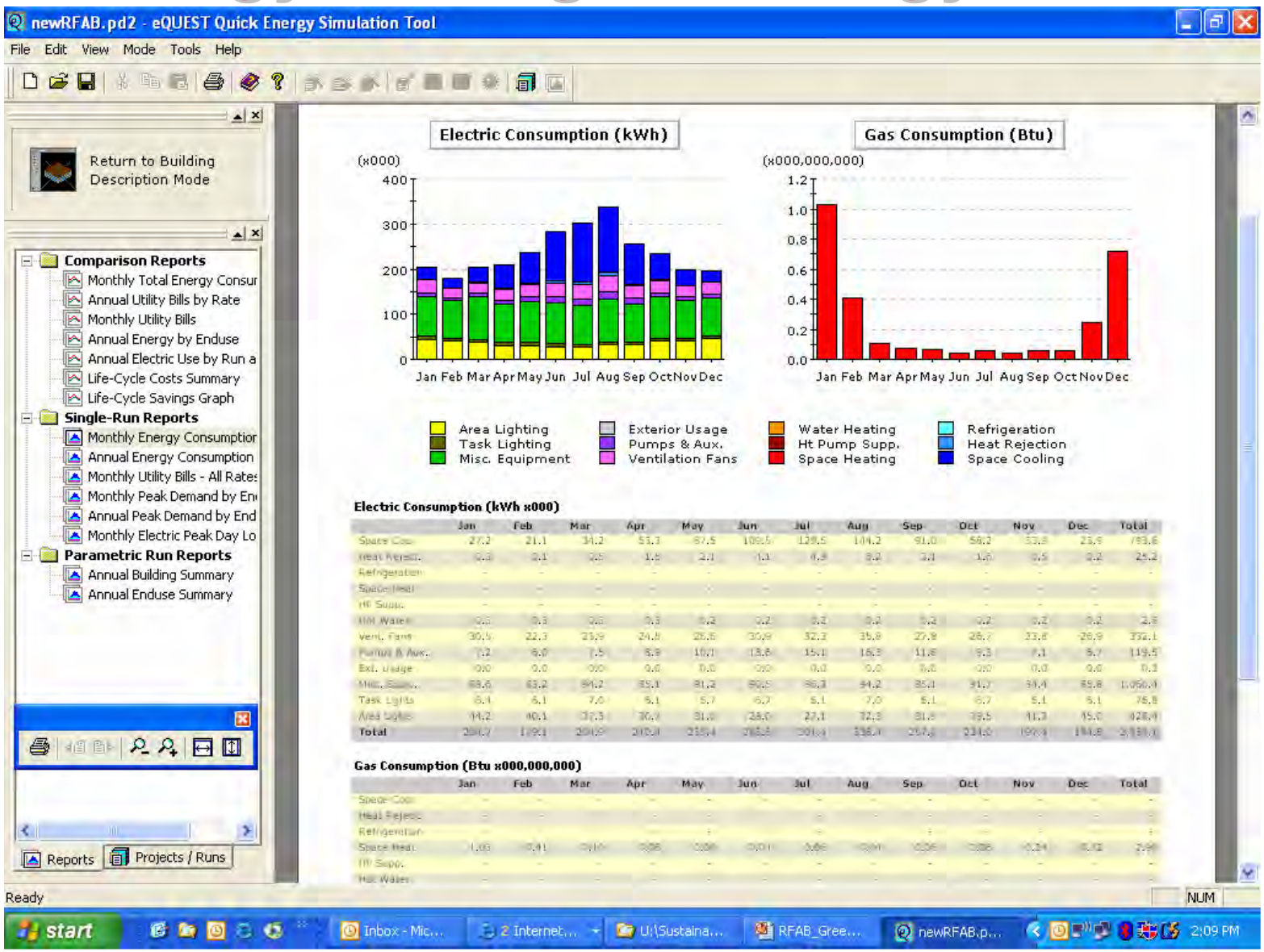
- Vacuum Pumps (*reduced cooling load by >300 tons*)
  - Met with suppliers to assess developments in pump efficiency, current OEM testing, and future plans
  - Worked with Sematech and vendors to agree on an idle signal protocol
- Exhaust (*reduced exhaust load by >100,000 cfm*)
  - Return some general exhaust (heat) to space
  - Identify top tool internal constraints and work w/suppliers
- PC Water (*reduced system flow by >3,000 gpm*)
  - Reduce pressure drop and increase delta T on tool and support equipment heat exchangers

Energy Savings – Shell and Admin

- Passive solar orientation with exterior shading
- Energy and Daylight modeling
- Optimized glazing (high VLT, low SHGC, low U value)
- Reflective roof (high reflectivity, high emissivity)
- Natural daylighting with light shelves
- High efficiency lighting (motion + daylight sensors)
- Demand controlled ventilation (control on CO_2)
- Attention to detail on insulation and infiltration



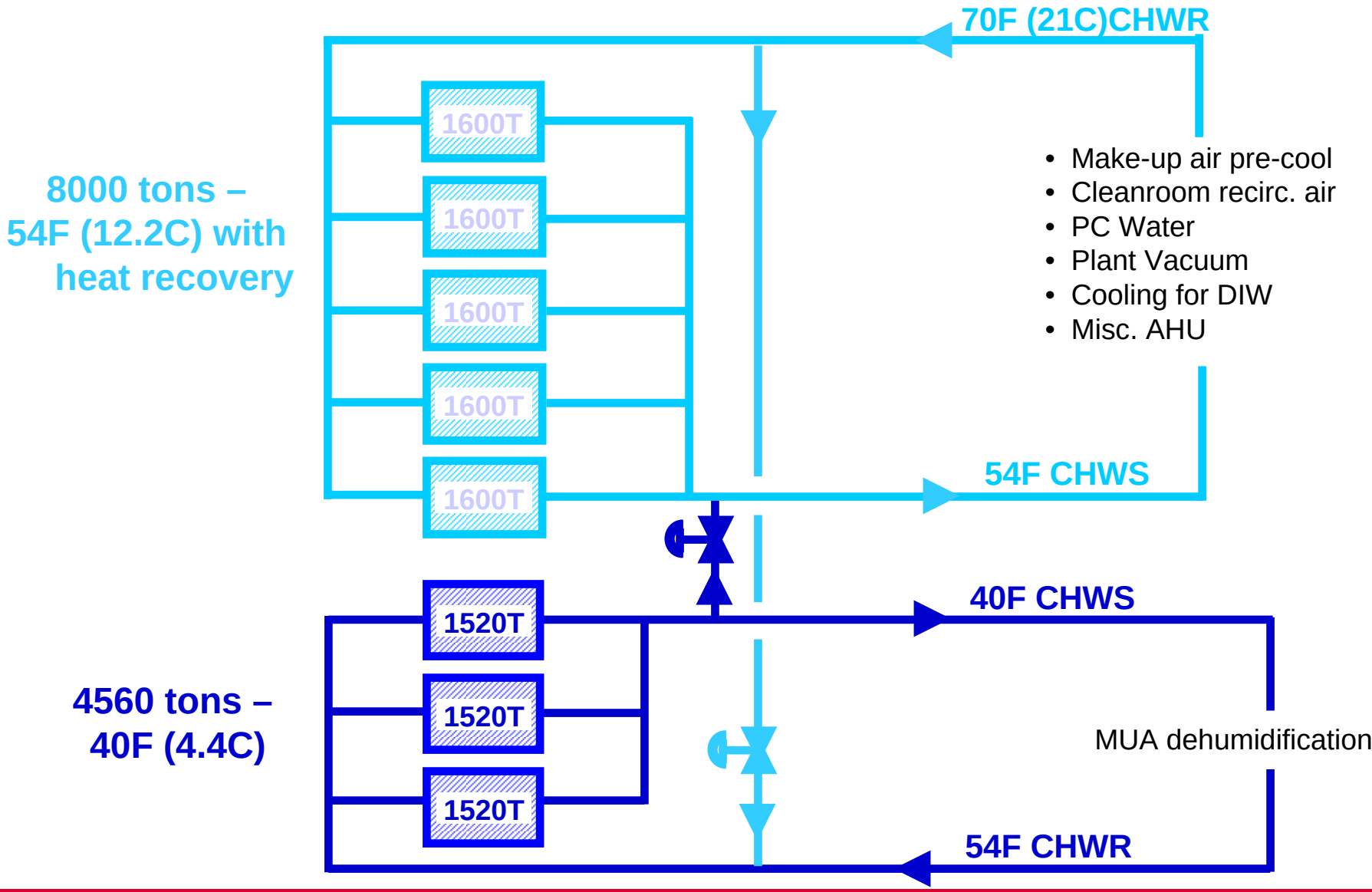
Energy Savings – Energy Model



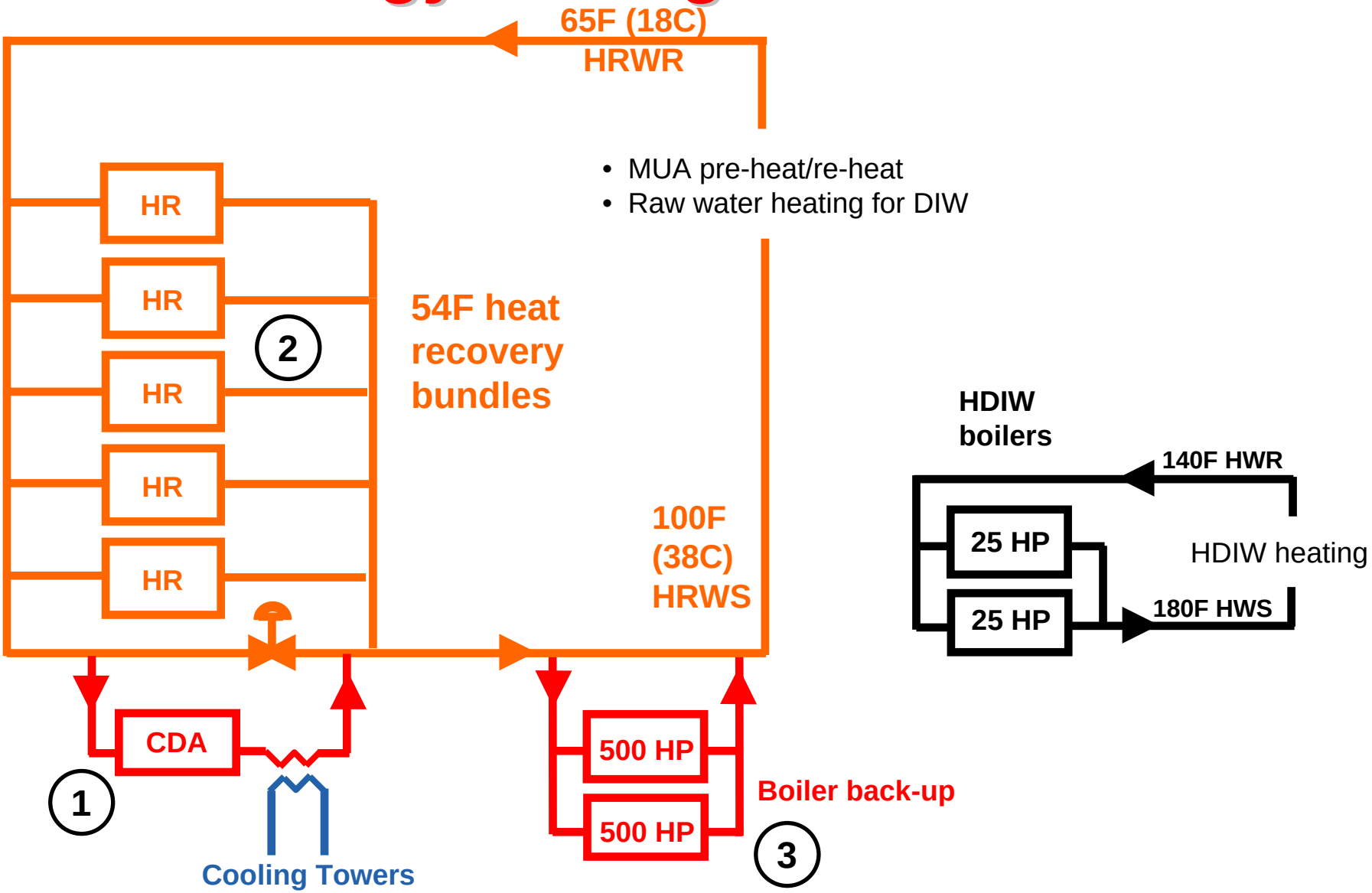
Energy Savings – Central Utilities Plant

- Chiller Plant (25% of fab load)
  - Split plant to match needs to capacity
    - 40 deg F for dehumidification (.44 - .51 kW/ton)
    - 54 deg F for all other loads (.32 - .50 kW/ton)
  - Heat Recovery on 54 degree plant (75% of CHW load)
    - More constant load year round
    - Minimal energy penalty for free hot water
    - Reduced boiler count from 6 to 2 (500HP each)
  - Utilize variable primary distribution
  - Redundancy is 1 x 40F chiller for both 40F and 54F (blending for 54F)

Energy Savings – Chiller Plant



Energy Savings – Hot Water



Energy Savings – MUA and Recirc

- Make Up Air
  - Utilized run around coils for free reheat
  - Lowered face velocity to <400 fpm to reduce fan HP
  - Used high pressure humidification instead of steam
  - Investigating enthalpy wheel recovery
    - Recaptures >70% of the exhaust enthalpy
- Recirculating Air
  - 25% HEPA coverage (*300 ton load reduction vs. 50%*)
  - Tested FFU bidders and selected based on efficiency
    - At 90 fpm = 6100 cfm/kW (very good)
    - Reduce filter pressure drop, minimize velocity
    - At 70 fpm > 8000 cfm/kW (excellent)

Energy Savings - Pumps, Fans, & More

- Utilize the Big Duct, Small Fan & Big Pipe, Small Pump Idea – minimize friction loss
- Utilize Variable Frequency Drives and minimize balancing valves (drive with accelerator, not brake)
- Continue to use premium efficiency motors

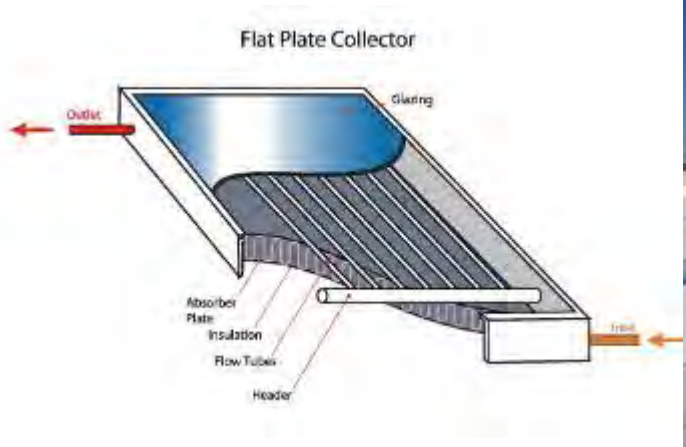
COULD HAVE DONE EVEN BETTER

- Underfloor air distribution / displacement ventilation
- More daylighting / skylights – especially in the core
- Piping distribution friction minimization – some progress
- Enthalpy wheels and Munters HCU

While I'm proud of what we have accomplished, I'm excited about how much more we now know we can do.

Energy and Atmosphere

- ✘ EA Credit 2.1 Renewable Energy, 5%
- ✘ EA Credit 2.2 Renewable Energy, 10%
- ✘ EA Credit 2.3 Renewable Energy, 20%
- ☑ EA Credit 3 Additional Commissioning
- ☑ EA Credit 4 Elimination of HCFC's and Halons
- ☑ EA Credit 5 Measurement and Verification
  - ✪ "If you don't measure it – you can't manage it"
- ? EA Credit 6 Green Power



Materials and Resources

- ✘ MR Credit 1.1 - Building Reuse, Maintain 75% of Existing Shell
- ✘ MR Credit 1.2 - Building Reuse, Maintain Additional 25%
- ✘ MR Credit 1.3 - Building Reuse, Maintain 100% Shell & 50% Non-Shell
- ☑ MR Credit 2.1 - Construction Waste Management, Divert 50%
- ☑ MR Credit 2.2 - Construction Waste Management, Divert 75% *We are at >90% construction waste recycling*

Materials and Resources

- ✘ MR Credit 3.1 - Resource Reuse, 5%
- ✘ MR Credit 3.2 - Resource Reuse, 10%
- ☑ MR Credit 4.1 - Recycled Content, Specify 5% p.c. or 10% p.c. + p.l.
- ☑ MR Credit 4.2 - Recycled Content, Specify 10% p.c. or 20% p.c. + p.l.
- ☑ MR Credit 5.1 - Local/Regional Materials, 20% Manufactured Locally
- ✘ MR Credit 5.2 - Local/Regional Materials, of 20% Above, 50% Harvested Locally
- ✘ MR Credit 6 - Rapidly Renewable Materials
- ☑ MR Credit 7 - Certified Wood

Indoor Environmental Quality

- ☑ IEQ Prerequisite 1 - Minimum IAQ Performance
- ☑ IEQ Prerequisite 2 - Envir Tobacco Smoke (ETS) Control
- ☑ IEQ Credit 1 - Carbon Dioxide (CO2) Monitoring
- ? IEQ Credit 2 - Increase Ventilation Effectiveness
- ☑ IEQ Credit 3.1 - Construction IAQ Management Plan, During Construction
- ☑ IEQ Credit 3.2 - IAQ Mgmt Plan, Before Occupancy

Indoor Environmental Quality

- ☑ IEQ Credit 4.1 - Low-Emitting Materials, Adhesives & Sealants
- ☑ IEQ Credit 4.2 - Low-Emitting Materials, Paints
- ☑ IEQ Credit 4.3 - Low-Emitting Materials, Carpet
- ☑ IEQ Credit 4.4 - Low-Emitting Materials, Composite Wood

Adhesives and Paints have been difficult – not due to availability, but awareness of alternate products. Diligent review of submittals and educating contractors was paramount.

Indoor Environmental Quality

- ☑ IEQ Credit 5 - Indoor Chemical and Pollutant Source Control
- ✘ IEQ Credit 6.1 - Controllability of Systems, Operable Windows, Perimeter
- ✘ IEQ Credit 6.2 - Controllability of Systems, Individual Controls, Non-Perimeter
- ☑ IEQ Credit 7.1 - Thermal Comfort, Comply with ASHRAE 55-1992
- ☑ IEQ Credit 7.2 - Thermal Comfort, Permanent Temperature & Humidity Monitoring
- ✘ IEQ Credit 8.1 - Daylight and Views, Diffuse Sunlight to 75%
- ☑ IEQ Credit 8.2 - Daylight and Views, Views for 90% of Spaces

Innovation

- There are also (4) additional points available for innovation and/or areas where you achieve well above and beyond the standard credit point
- There is (1) point for having a LEED Accredited Professional working on the project
- Big Benefit of LEED
  - Provided a mechanism to get people to focus on making good choices for the long term good of the building and occupants

Cost / Benefit

- We will invest <1% of the project cost (<$1.5M) in LEED related items – predominately efficiency improvements that we would consider regardless of LEED
- But remember that the overall project cost 30% **LESS** than our previous 300mm fab.
- The first full year we should recover $1M in operating savings
- At full build out we will save >$4.0M per year in operating costs`
  - 20% energy reduction
  - 35% water use reduction
  - 50% emissions reduction