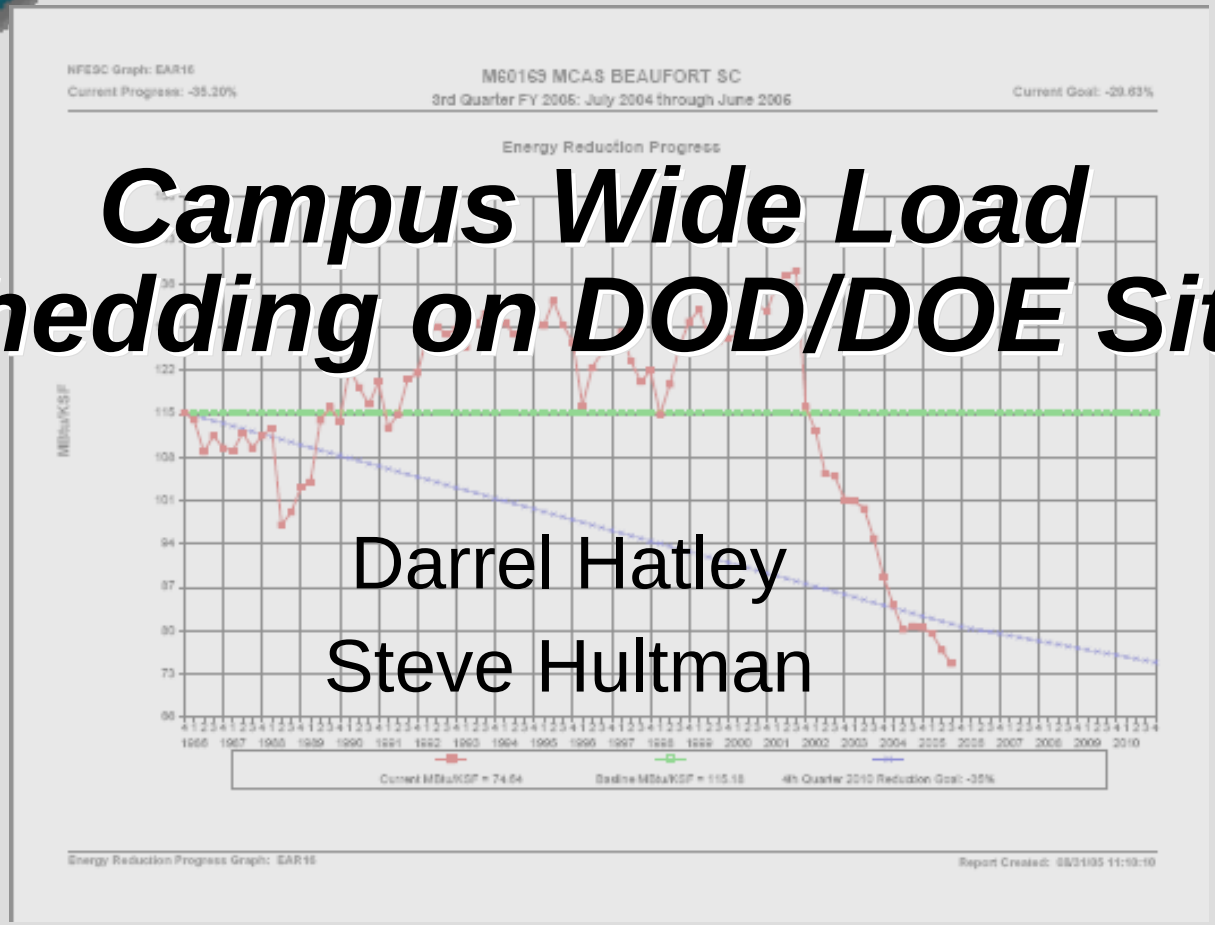
Campus Wide Load Shedding on DOD/DOE Site



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Operated by Battelle for the U.S. Department of Energy

Outline

- Base descriptions
- Project objectives
- Project outline
- Technical descriptions
- Energy results
- Q&A

Load Shedding Energy at DOD Sites

- Marine Corps Air Station (MCAS)
  Beaufort, South Carolina

MCAS Base

- Summer peak temperatures range up to 100 F and 95% humidity
- 2.8 mil square feet
- 100+ Major buildings heating and cooling
- 74 Buildings fully automated with energy Management Control Systems (EMCS)
- 4000+ personnel, 1200 housed on base
- 7 squadrons of fighter planes

Project Objectives, Goals and Cost

- Cut Energy and Peak Demand
  - Mostly electric and some gas
  - Normal peaks of 10 MW in summer
  - Ratchet clause of 85% year round
- 18% Predicted Dollars Savings
- Overall Cost ~ $2.6 M, First Phase
  - Split into 4 phases for funding
  - 3.97 savings to investment ratio
  - Predicted 7 year payback
  - $450K / year savings energy, $600K overall

Project Objectives, Goals and Cost (cont.)

- Move the energy needs around the base as staff move.
  - Limit energy in non used space as staff leave barracks and move to work locations.
  - If major equipment is run for short periods of time then limit loads else where.
- Provide for a multi layer, priority based, site wide, load shedding and control scheme.
- Provide for new energy control schemes with limiting capabilities, chilled water reset, VAV reset, optimal start/stop, ice storage interfaces and schemes.

Project Outline

- Capture single main electric meter data reliably in real time.
- Upgrade EMCS system in a major number of high energy using facilities.
- Establish an Ethernet LAN system independent of the base LAN for Utility SCADA use. Phase 5 work.
- Put all upgraded facilities on LAN so they all work as one integrated load shedding system.
- Broadcast demand curtailment data to all facilities and major equipment.

As Found

- Meter data was intermittent and not reliable.
- Only a few buildings with enough controls to perform any energy routines.
- Several different venders on site. No communications.
- Most EMCS systems in disrepair and in override (Jumpers).
- Peak Demands with Ratchet clause was extremely costly.
- Several ice storage systems on base but not functioning with a overall scheme or in disrepair.

Implementation

- Onsite building walk-downs with the DDC contractor and customer. Tenant complaints along with energy where noted.
- A priority short list of likely facilities to start the project was developed.
- Acquired drawings from Base Engineering of the facilities for building modeling

Implementation (cont.)

- Modeled each facility as it was found.
- Building rooms being over cooled with windows open, supply fans running 24/7, no chiller controls, hanger lights on 24/7, hanger doors left open, etc..
- Then Modeled each facility with the new PNNL designed Load Shed Scheme and DDC energy saving controls.

Implementation (cont.)

Some Examples:

- PNNL Building Load Shed Control, 10 layers deep, 4 layers wide.
- Limit chilled water valves and reset space temperatures.
- Reset the supply chilled water temperatures.
- Control space heaters in large hangers with wireless proximity sensors that would turn off the heaters if the main doors were open too wide.

Implementation (cont.)

Some Examples cont:

- Control hanger lighting with light meters and schedules, instead of manually. Wireless interface to doors.
- Schedule Barrack supply fans to actual needs, (when occupied) instead of running 24/7.
- Schedule complete shutdown of Barracks when troops were deployed.
- When other HIGH Load equipment had to run, we then shed other High Loads (400 Hp Fire booster pumps on, non-essential chillers off).

Implementation (cont.)

- Compared the energy saving & dollars to the total installation cost:
  - Pay back was less than 7 years
  - DDC project cost were within price control restraints
- Used a local DDC vender as a bidder design contractor:
  - Directed and wrote the control schemes they installed.
  - Full functional testing at each step
  - Trained their installers and commissioning agents to what we wanted and required
  - Used one vender for most of project

How Does the Load Shedding Work?

- 40 layer matrix load shedding scheme consist of:
  - 10 building layers for prioritizing facilities into:
    - Group 1 least significant facilities
    - Group 10 most significant facilities
    - Each facility can be put in a level that is appropriate for it mission
  - 4 load stages or schemes at each facility:
    - Stage 1 minor interruptions
    - Stage 4 major interruptions

How Does the Load Shedding Work? (cont.)

- 40 layer matrix load shedding scheme consist of:
  - Stage 1 shed commands are sent out first in order of their grouping and load set points
  - Stage 2 shed commands are then sent out after all load 1 have been activated
  - Stage 3 then stage 4

Master Load Shed Group Settings

Target Base Load 8.0 MW

	Stage 1	Stage 2	Stage 3	Stage 4
Group 1	7800	7900	8000	8100
Group 2	7810	7910	8010	8110
Group 3	7820	7920	8020	8120
Group 4	7830	7930	8030	8130
Group 5	7840	7940	8040	8140
Group 6	7850	7950	8050	8150
Group 7	7860	7960	8060	8160
Group 8	7870	7970	8070	8170
Group 9	7880	7980	8080	8180
Group 10	7890	7990	8090	8190

Implementation

Stage Commands:

- **Stage 1**
  - T/Stat set-points move out One Degree from normal set-point.
- **Stage 2**
  - T/Stat set-points move out Two Degrees from normal set-point and some chilled water valves reduce to 75% maximum open.
- **Stage 3**
  - T/Stat set-points move out Four Degrees from set-point and the chilled water valves reduce to 25% maximum open.
- **Stage 4**:
  - Turns Main Chillers and A/C Off, and as a backup closes all chilled water valves. Tries not to exceed Max. set-point. Also default when in network outage.

Implementation (cont.)

Full Complement of Unoccupied sequences installed:

- **Shut off fans:**
  - **Shut off early in some cases 15 to 30 minutes before scheduled unoccupancy.**
- **Unoccupied tenant overrides.**
- **Low limits.**
- **High limits.**
- **Ice making events active.**

Utility Rates

MCAS

- Peak Hours 1:00 pm – 9:00 pm
- Energy Charge on peak $0.04989 /KWh
- Energy Charge off peak $0.02792 /KWh
- Demand On Peak $14.58
- Demand Off Peak $4.40

Current settings On-Peak 8.0 Megawatt Off-Peak 9.5 Megawatt

- During the **Summer months of June through September**, between the hours of 12'oclock noon and 9 P.M., Monday thru Friday, excluding holidays the EMCS system will control to a preset Demand Limit set-point maximum value. (On Peak) Stating at 11 A.M., the EMCS system starts ***ramping down*** to be able to achieve set-point at the start of period. All other days and times the EMCS system will control to a preset maximum megawatt setting. (off-Peak)

Current settings On-Peak 8.0 Megawatt Off-Peak 9.5 Megawatt (cont.)

- During the **Winter months of November through April**, between 6 A.M. & 12 noon and between 5 P.M. & 9 P.M., Monday thru Friday, excluding holidays the EMCS system will control to 80 % of the highest previous summers peak established. (On-Peak) All other days and times the EMCS system will control to a preset megawatt setting.

Current settings On-Peak 8.0 Megawatt Off-Peak 9.5 Megawatt (cont.)

- During the shoulder months of **October & May**, between the hours of 12'oclock noon and 9 P.M., Monday thru Friday, excluding holidays the EMCS system will control to a preset megawatt setting. (On-Peak) Also on these days at 11 A.M., the EMCS system starts ramping down to be able to start at the preset set setting. All other days and times the EMCS system will control to a preset megawatt setting. (Off-Peak)

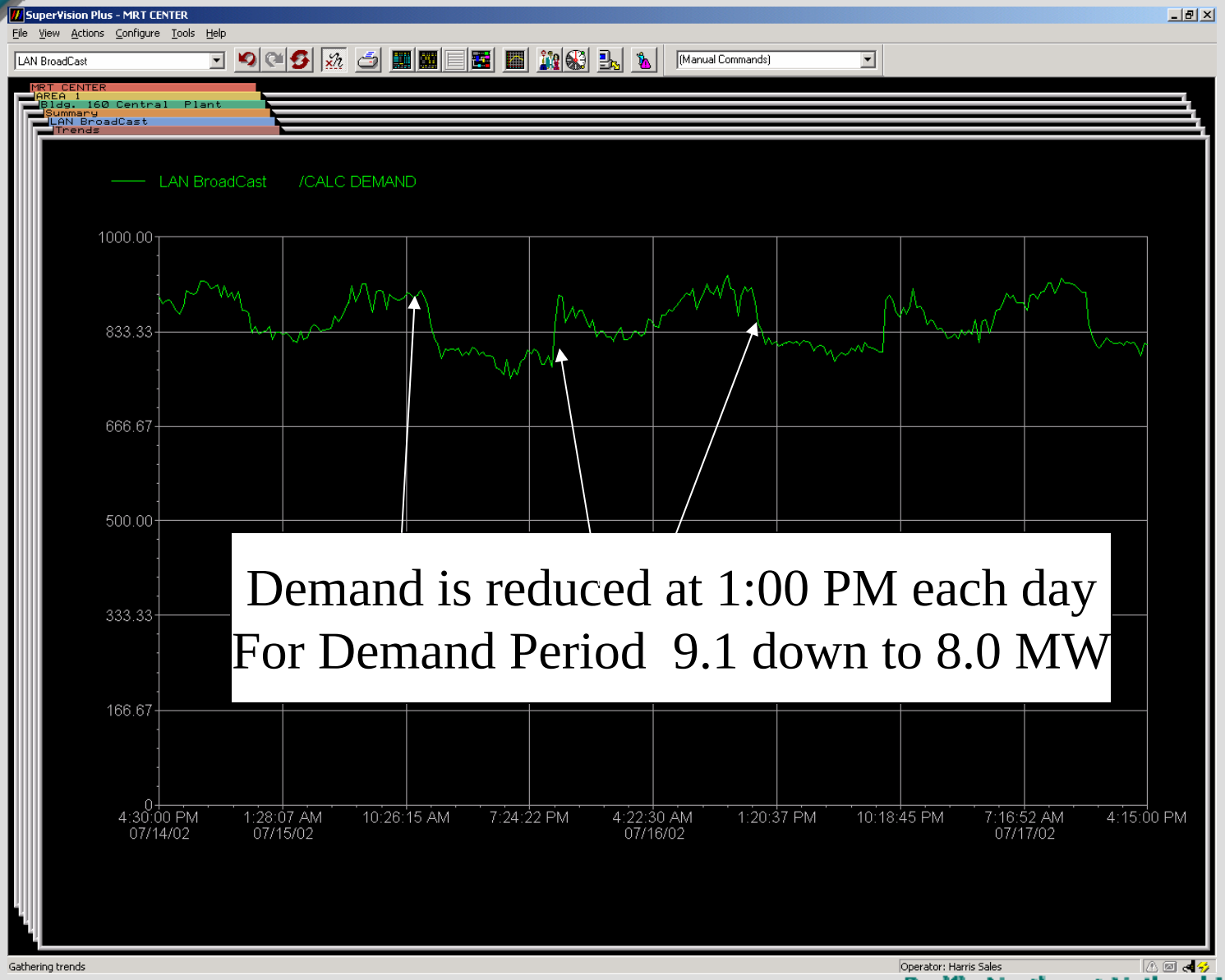
Results to Date

- Operation of 74 facilities as a single site wide scheme.
- Front-end that can see the complete operations.
- SCADA Utility infrastructure and LAN installed.
- One staff person **took ownership** and works part time watching system.
- Peak demands reduced by 10%, 1 full MW.
- Ratchet clause penalty reduced.
- Ice storages systems repaired and running.

Results to Date, Energy Dollar Savings Only

- Base year 98 through 00 average.
- FY 01 $ 344 K
- FY 02 $ 734 K
- FY 03 $1,304 K
- FY 04 $1,504 K
- Total To FY 04 Date $3,886 K

- 3.5 year simple pay back.



Demand is reduced at 1:00 PM each day
For Demand Period 9.1 down to 8.0 MW

Today's Profile with Cogeneration Running

NFESC Graph: EAR16

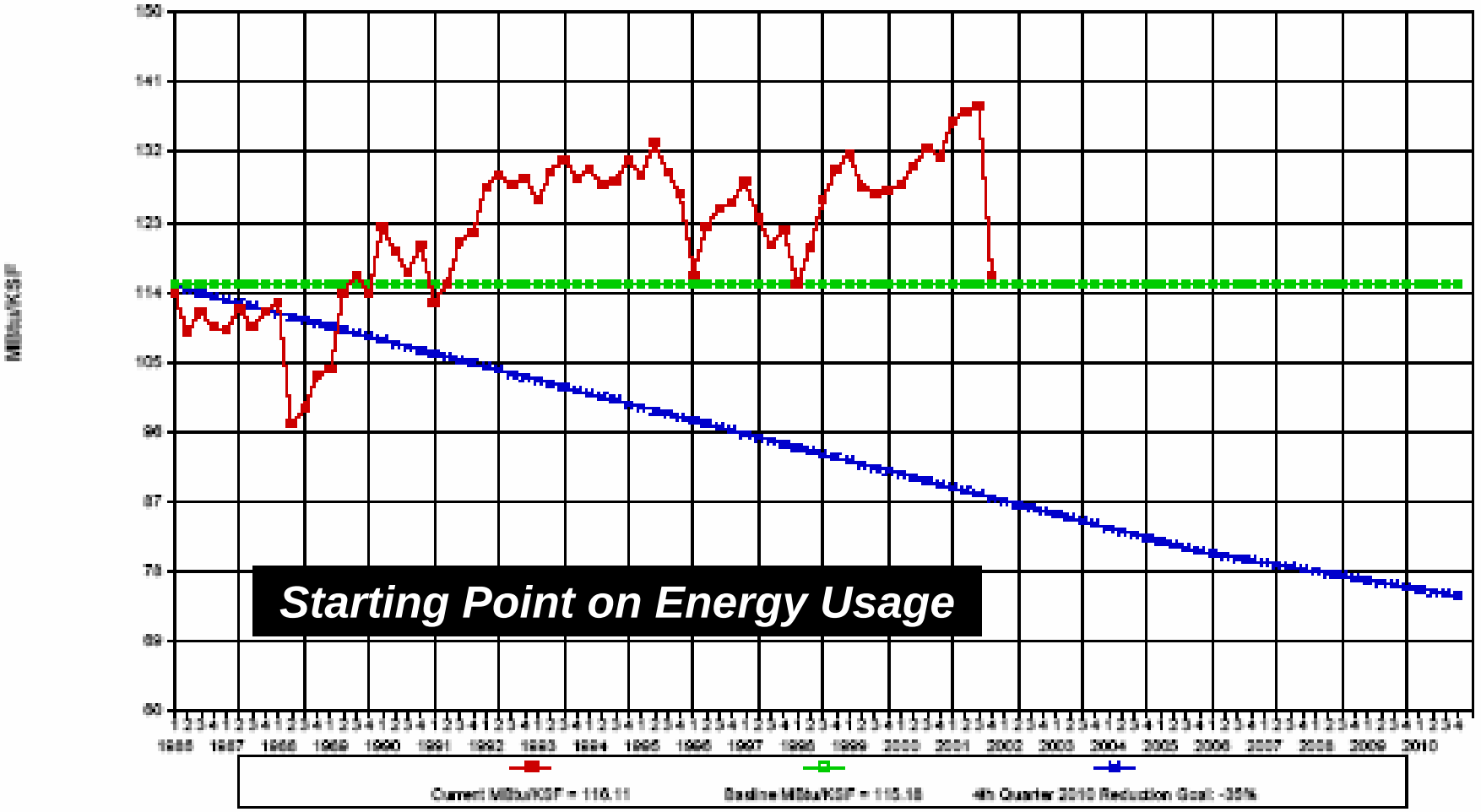
Current Progress: 0.81%

M60163 Marine Corps Shore Activities

4th Quarter FY 2001: October 2000 through September 2001

Current Goal: -24.00%

Energy Reduction Progress



NFESC Graph: EAR16

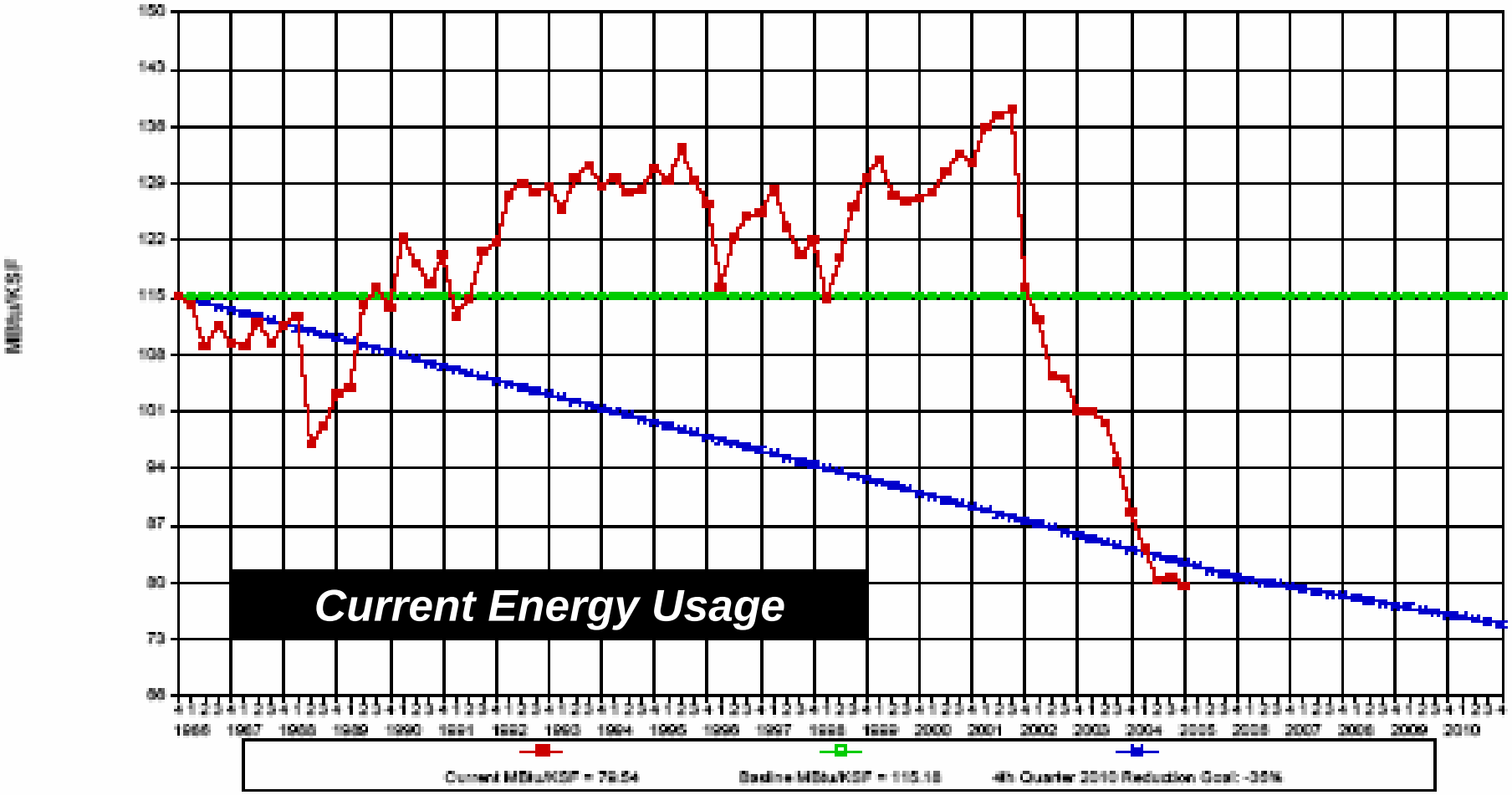
Current Progress: -30.94%

M60169 MCAS BEAUFORT SC

4th Quarter FY 2004: October 2003 through September 2004

Current Goal: -28.50%

Energy Reduction Progress

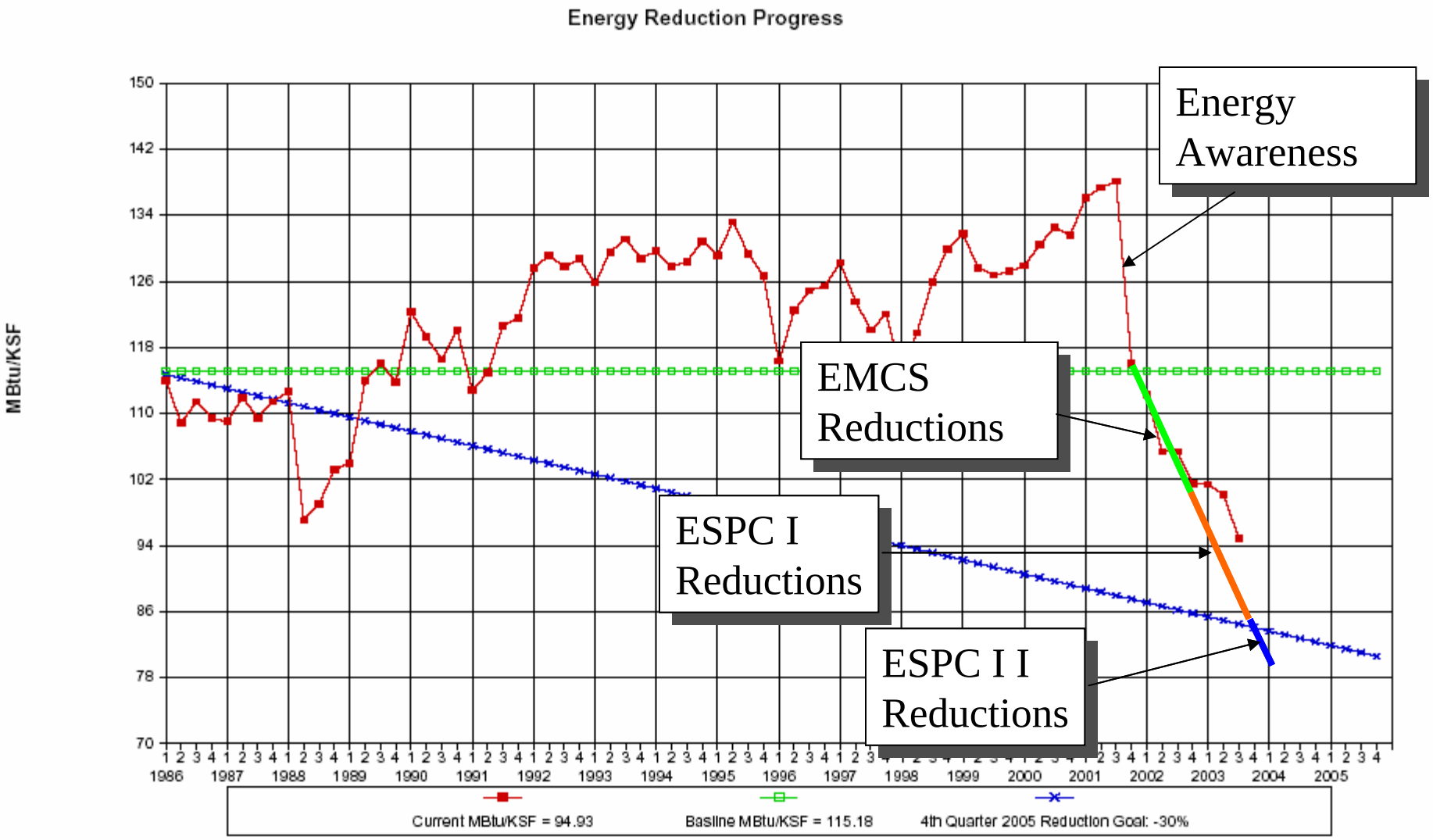


NFESC Graph: EAR16
Current Progress: -17.58%

MCAS BEAUFORT SC - M60169 Marine Corps Shore Activities

3rd Quarter FY 2003: July 2002 through June 2003

Current Goal: -26.63%



Recipe for Success

- Base Commander support.
- Maintenance support.
- A mission that will allow some flexibility.
- A major player who will take ownership.
- A contractor who is willing to work with you.
  - Wants to see a good product and not just charge extras.
- A good oversight engineering group to see the big picture.
- Some funding to get started.

Q & A

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