SEDAC RCx Analysis and Energy Assessment of Memorial Stadium- Yr 1 Wrap Up Call 3/17/17

Attendees: DIA: Brett Stillwell, Lenny Willis SEDAC: Simon Nowak, Eileen Westervelt

1. **Two Reports Issued:**
   A. Memorial Stadium RCx Plan 3.3.17
   B. Memorial Stadium Level 2 Energy Assessment (RCx supplement) 3.6.17
2. **Savings**

   RCx Analysis and Energy Assessment show very significant opportunity for cost effective savings.
   A. **Target Return (Quick Return) RCx Package (RCxMs 1-4,7-8)**
      12% cost savings ($135k/yr) with a 0.94 yr pay back of a $126k investment.
   B. **All RCx Measures (High Impact) RCx Package (RCxMs 1-8)**
      42% cost savings ($461k/yr)with a 2.2 yr payback of a $1M investment
   C. **All Energy Cost Reduction Measure Package (ECRMs1-3)** *from Level 2 Energy Assessment*
      5% cost savings ($58k/yr) with a 4.8 yr payback of a $280k investment.
      Measures that don't qualify for RCx investment.
   D. **All identified opportunities** (**RCxMs 1-8 + ECRMs 1-3)**
      47% cost savings ($520k/yr) with a 2.5 yr payback of a $1.3M investment
3. **Incentives**
   A. Act Now.
   B. Custom incentives need pre-approval.
4. **Prioritization of Measures**
   A. Planned renovations will dictate implementation order.
   B. Technical RCx of West Side and West Great Hall Roller Doors high priority.
5. **Customer Selection/ Interest in Identified Measures**
   A. Customer Selection Form for RCxMs
   B. Customer Interest Form for ECRMs
6. **Additional Measures** not analyzed:
   A. Enclosing East Side piping under upper stands
   B. Demand control ventilation on kitchen hoods
   C. Heat recover on exhaust in North End
   D. Potential 25T chiller Upgrade (Not installed in 2002 as planned –Old unit on roof).
7. **SEDAC Bookkeeping:**
   A. Will need to draw a boundary around a measure to count toward SEDAC RCx commitment.
   B. Will continue to track expenses with work order #10479045.
   C. TBD who will follow up (SEDAC, Ameren)

Customer Selection Form of Retro-commissioning Measures

RCxM No.	Measure Description	Projected Annual Savings												Impleme-ntation Cost ($)	Available DCEO Incentives ($)	SPB Without Incentives (Years)	SPB w/ Incentive (Years)	RCxM Packages		Client Response		
		Electric Savings at Bldg (kWh)	Electric Cost Savings ($)	Steam Savings (MMBTU)	Steam Cost Savings ($)	Central Chilled Water Savings (MMBTU)	Chilled Water Cost Savings ($)	Central Plant kWh Savings from CHW savings (kWh)	Combined Elec kWh savings (Bldg +Central Plant)	Combined NG Savings (Bldg + Central Plant) (therms)	Site Energy Savings (%)	Total Cost Savings ($)	Facility Cost Savings (%)					Program RCxM Package (X)[3]	Total RCxM Package (X)	Measure Selected by Owner[6,7] (X)	Intend to Apply for Incentives[7] (Yes/No)	Estimated Completion Date
1	Lighting Occupancy Sensors	149,983	$12,442	-	$0	-	$0	-	149,983	-	0.1%	$12,442	1%	$19,095	$5,297	**1.5**	1.1	x	x			
2	Automate Lighting in East Stands and East Great Hall Ramps	160,650	$13,327	-	$0	-	$0	-	160,650	-	0.1%	$13,327	1%	$12,695	$0	**1.0**	1.0	x	x			
3	Close East Side Rest Rooms Non-Game Days	670,990	$55,662	-	$0	-	$0	-	670,990	-	0.4%	$55,662	5%	$37,360	$0	**0.7**	0.7	x	x			
4	Automate East Great Hall Bay Lights	218,805	$18,151	-	$0	-	$0	-	218,805	-	0.1%	$18,151	2%	$12,540	$0	**0.7**	0.7	x	x			
5	Technical RCx - West Central	162,584	$13,487	4,203	$74,294	2,610	$43,446	167,025	329,610	47,096	13%	$131,227	12%	$399,000	$138,436	**3.0**	2.0		x			
6	Technical RCx - North Stadium	498,522	$41,355	7,680	$135,749	1,085	$18,062	69,439	567,961	86,053	16%	$195,167	18%	$497,000	$283,287	**2.5**	1.1		x			
7	Roller Doors in West Great Hall	-	$0	1,152	$20,357	-	$0	-	-	12,904	2%	$20,357	2%	$19,120	$0	**0.9**	0.9	x	x			
8	West Great Hall Pressure Reciew, VFDs on Exhaust Fans	34,156	$2,833	685	$12,102	-	$0	-	34,156	7,671	1%	$14,935	1%	$25,425	$1,705	**1.7**	1.6	x	x			
	Target Return (SPB < 1.5yr) Package[3,5]	**1,234,584**	**$102,416**	**1,836**	**$32,458**	**-**	**$0**	**-**	**1,234,584**	**20,575**	**11%**	**$134,874**	**12%**	**$126,235**	**$7,002**	**0.9**	**0.9**					
	All RCxM Package[4,5]	**1,895,690**	**$157,258**	**13,720**	**$242,502**	**3,694**	**$61,508**	**236,464**	**2,132,155**	**153,723**	**44%**	**$461,268**	**42%**	**$1,022,235**	**$428,725**	**2.2**	**1.3**					

Key: RCxM= Retro-commissioning Measure, ECRM=Energy Cost Reduction Measure, DCEO=Department of Commerce and Economic Opportunity
IEN=Illinois Energy Now (DCEO's Energy Program), EEPS=Energy Efficiency Portfolio Standards
SPB=Simple Pay Back, IRR=Internal Rate of Return, NPV=Net Present Value

***Anticipated changes in the administration of the EEPS program may change availability and amount of incentives.**

Customer Interest Form Level 2 Energy Assessment Measures:

ECRM #	Description	Potential Energy Savings				Estimated Project Cost	Potential Incentive	SPB w/o Incentive (yrs)	SPB w/ Incentive (yrs)	Interested in Implementing?		Estimated Completion Date
		kW	kWh	Therm	$					Yes	No	
1	Upgrade MV lighting to LED	0	240,644	$0	$19,963	$126,255	$34,121	*6.3*	*4.6*			
2	Upgrade of Older Cooling Equipment (3 DX Units)	0	6,691	0	$555	$49,000	$1,750	88.3	85.1			
3	Schedule Refrigeration and Ice Machines	0	456,828	0	$37,896	$105,580	$39,125	2.8	1.75			
PKG ECRMs1&3	ECRMS1 & 3	0	697,472.5	-	$57,859	$231,835	$73,245.6	4.0	2.7			
PKG All	All Measures (ECRMS1,2,3)	0	704,164	-	$58,414	$280,835	$74,996	4.8	3.5			

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#	Retro-Commissioning Measure Description
RCxM-1	**LIGHTING OCCUPANCY SENSORS** There are many intermittently used areas where lighting is controlled by manual switches. These areas (which include rest rooms, storage areas, offices, locker rooms, and hallways) have been found to have their lights on when unoccupied. This measure recommends installing occupancy sensors in order to control the lighting based on occupancy. Occupancy sensors would permit the lights to turn off automatically if they were left on after hours, during breaks, or when the space is otherwise unoccupied. This will result in energy savings by reducing lighting operating hours.
RCxM-2	**AUTOMATE LIGHTING IN EAST STANDS AND EAST GREAT HALL RAMPS** There is a significant amount of Mercury Vapor lighting in the East Stands and East Great Hall ramps that is run 24/7/365 in spaces that are only used on game days. This measure recommends installing automated control and scheduling of this lighting to turn off lights when not needed. This will result in energy savings by reducing lighting operating hours.
RCxM-3	**CLOSE EAST SIDE RESTROOMS ON NON-GAME DAYS,** The Rest Rooms in the Upper and Lower East Great Hall (EGH) are lit, ventilated and heated with electricity year round with very little use. This measure recommends closing these rooms to public access on non-game days and installing automated control and scheduling of the lighting & ventilation, to turn off lighting and ventilation on non-game days. This will result in energy savings by reducing operating hours of lights, ventilation fans, and unit heaters.
RCxM-4	**AUTOMATE EAST GREAT HALL BAY LIGHTS** Seventy-eight 400W MV fixtures are lit 24/7/365. There is limited use of the East Great Hall (EGH) on non-game days and full illumination is not required**.** This measure recommends installing automated control and scheduling of this lighting and will result in energy savings by reducing lighting operating hours.

RCxM-5

TECHNICAL RCx - WEST CENTRAL WING

The HVAC equipment that serves the West Central Wing is challenged by an unreliable BAS network; assorted equipment malfunctions; and suboptimal schedules, set points, and control routines. This measure recommends:

1) ***upgrading the BAS*** network to enable reliable control, (**TOP priority and prerequisite for savings**)
2) ***installing VFDs*** on exhaust Fans 9 &10 to allow as-designed ventilation routines,
3) systematically ***reviewing equipment operations*** and identifying and resolving equipment operational faults,
   observed faults include: failed sensors, leaking valves, overridden schedules, failure to meet setpoints, simultaneous heating and cooling, controllers acting opposite to intention, variable motor drives that never vary, gross over-ventilation, and
4) ***adjusting schedules, setpoints and control routines*** to efficiently provide needed conditioning when spaces are used and set back conditioning where spaces are unoccupied.

Current Typical Schedules and Setpoints:

Ventilating 91-168 hrs/wk for spaces occupied 0-50hrs/wk.

Room Temperature Setpoints:

	occupied	unoccupied	Relative Humidity
heating	72 F	60 F	
cooling	68 F	80 F	45%

Proposed Typical Schedules and Setpoints:

Ventilating only when occupied.

Room Temperature Setpoints:

	occupied	unoccupied	Relative Humidity
heating	68 F	60 F	
cooling	72 F	80 F	55%

This measure will result in energy savings due to correct and efficient operation of equipment from repair and tightened control of space conditioning efforts.

RCxM-6

TECHNICAL RCx - NORTH STADIUM FACILITIES

The HVAC equipment that serves the North Stadium (North East Tower: Football Headquarters, North Central: Football Performance Center, and North West Tower) is challenged by a multiplicity of control systems (Schneider, Siemens, Johnson); assorted equipment malfunctions; and suboptimal schedules, set points, and control routines. This measure recommends:

1) ***upgrading pneumatic HVAC controls to DDC*** and connecting HVAC equipment to the main BAS for reliable, centralized, and more sophisticated control
2) systematically ***reviewing equipment operations*** and identifying and resolving operational faults,
   observed faults include: failed sensors, leaking valves, overridden schedules, failure to meet setpoints, simultaneous heating and cooling, controllers acting opposite to intention, variable motor drives that never vary, gross over-ventilation, and
3) ***adjusting schedules, setpoints and control routines*** to efficiently provide needed conditioning when spaces are used and set back conditioning where spaces are unoccupied.

Current Typical Schedules and Setpoints:

Ventilating 168 hrs/wk for spaces occupied 0-50hrs/wk.

Room Temperature Setpoints:

	occupied	unoccupied
heating	72 F	60 F
cooling	67 F	80 F

Proposed Typical Schedules and Setpoints:

Ventilating only when occupied.

Room Temperature Setpoints:

	occupied	unoccupied
heating	68 F	60 F
cooling	72 F	80 F

This measure will result in energy savings due to correct and efficient operation of equipment from repair and tightened control of space conditioning efforts.

RCxM-7	**ROLLER DOORS IN WEST GREAT HALL** There are two entrances to the West Great Hall which tend to be open 16 hrs per day: the stadium doors at Gate 24, and the vomitory (portal) door at Corridor “SS”. These open doorways allow easy passage through the west side both by foot traffic and by building personnel on motor carts. These open doors can admit large amounts of outside air into the space which is then heated by cabinet unit heaters and unit heaters. This measure recommends Installing a high speed overhead roller door inside the stadium doors at Gate 24 and potentially replacing the rolling door at Corridor "SS" to allow facility personnel to enter and exit the building easily and keep these doorways closed to reduce space heating needs by reducing infiltrating air from the outside.
RCxM-8	**WEST GREAT HALL (WGH) PRESSURE REVIEW, VFDs ON EXHAUST FANS** The West Great Hall is under a steady negative pressure when the Suites are scheduled as occupied because the exhaust is at least 8.3 kcfm greater than air supplied to the space (which is 13,200cfm). There are several exhaust fans (EFs 1,2,5,&6) that serve concessions and restrooms that turn on whenever floors 6-8 on the West Central Wing are used. Except for game days, this exhaust is not needed, and increases heating costs. Additionally, it should be noted that when the planned VFDs for EF 9&10 are added to the facility (as part of RCxM5), this imbalance will be larger. This measure recommends reviewing the pressurization in the hall and adding VFDs to the exhaust fans. The smoke exhaust dampers should be inspected to be sure that they are fully closed to avoid a chimney effect in the exhaust chases. Additionally, any other drivers of negative space pressurization should be investigated and ameliorated if appropriate. If the pressurization study leads to a relatively neutral space pressurization when fans are off, then install VFDS on the exhaust fans to balance exhaust with pre-conditioned supply air dumped from the 6-8th floors.

#	Energy Cost Reduction Measure Description
ECRM-1	**UPGRADE MERCURY VAPOR LIGHTING TO LED** The facility has a significant amount of mercury vapor lighting in the East Stands, East Great Hall (EGH) Ramps and passageways, each of the four towers, and the East Great Hall Concourse. It has been the practice to run this lighting 24/7/365. Mercury vapor lighting is becoming obsolete due to the higher efficiency, better color balance, longer life, and instant restrike of LED technology. This measure recommends replacing the Mercury Vapor lighting with LED lighting fixtures. 30W LED canopy fixtures are recommended to replace the 100W MV fixtures in the stands and ramps. 30W LED canopy fixtures with photocells are recommended to replace the 100W MV fixtures in the towers, and 150W LED High Bay fixtures are recommended to replace the 400W MV fixtures in the East Great Hall. Although site personnel are considering a retrofit of existing fixtures with LED panel retrofit kits and new diffusers, new fixtures are recommended in this analysis as the least cost alternative. There may be other considerations that would lead to choosing to retrofit existing fixtures. This will result in energy savings by reducing installed lighting wattage.
ECRM -2	**UPGRADE THREE OLDER DX COOING UNITS** The facility is currently equipped with three larger (>=10 Ton) and older (32 year old, from 1985) cooling units which serve Air Handling Units 5, 6, &7 in the North Side. The three units are Direct Expansion Units (two are 12.5 Ton, and one is 10 Ton). The units are approaching the end of their useful life and should be considered for replacement. Based on the age and condition of the units, the EER was estimated to be 7.5 This measure recommends replacing these cooling units with high efficiency (13.7 EER) units. This will result in energy savings due to increased efficiency of equipment.
ECRM -3	**SCHEDULE REFRIGERATION AND ICE MACHINES** Refrigeration costs an estimated $77k/yr at the stadium. Most of the equipment runs 24/7/365. Much of the equipment has been found to be empty in the summer, and may only be needed during football season. This measure recommends scheduling refrigeration and ice machines to match needs by: 1) developing a spreadsheet inventory of refrigeration equipment. 2) visiting with food service vendors and others who use refrigeration equipment to determine actual refrigeration needs, 3) connecting the remaining 8 walk-in units to the BAS and scheduling their operation to match needs of the food service vendor, 4) installing a power cut off switch for each of the 37 concessions to kill power to refrigeration connected to a dedicated controllable power circuit for each concession stand and 5) write up and implement a procedure for systematically unplugging unneeded refrigeration equipment not connected to the BAS, and cleaning and disinfecting equipment at shutdown and startup.

RCxM No.	Measure Description	Costing Breakout	Measure Cost
1	**LIGHTING OCCUPANCY SENSORS** Install Occupancy Sensors in Intermittently Used Spaces	Survey: 2peoplex2daysx $60/hr = $1920 to survey options and develop scope and cost estimates. 51 wall sensors @ $125/sensor 76 ceiling sensors @$150/sensor	$ 19,095
2	**AUTOMATE LIGHTING IN EAST STANDS AND EAST GREAT HALL RAMPS** Turn Off Lighting in East and West Stands and East Great Hall Ramps When Unoccupied	4 hour investigation of circuits and concerns x $60/hr=$240 . A roll of "Do not Enter" barricade tape. @ $35. 2 people x 1 hour @ $60/hr to deploy tape. Assume 8 points at $1500/pt +300 schedule	$ 12,695
3	**CLOSE EAST SIDE RESTROOMS ON NON-GAME DAYS**	4 hrs to discuss issues, visit rooms, and write up procedures @ $60/hr. 2 hrs to identify circuits. 24 points to control lighting, ventilation of spaces: 20 points for lighting+4 points for ventilation fans @ $1500/pt + $1000 graphical interface and scheduling	$ 37,360
4	**AUTOMATE EAST GREAT HALL BAY LIGHTS** Turn off three-quarters of East Great Hall High Bay lights on non-game days	4 hrs to discuss issues and Identify circuits, 8 points @ $1500/pt, $300 schedule	$ 12,540
5	**TECHNICAL RCX - WEST CENTRAL WING** Upgrade BAS, Install VFDs (on EF 9&10), Verify Equipment Functioning and Control, Adjust HVAC Schedules and Setpoints to Needs	$100,000 for LON upgrade West, Tech RCx visit: 3 people for 8hr/day*5days/wk*26wks*$60/hr=$187,000 $35,000 parts (including VFDs for Exhaust Fans 9&10) 2 DDC specialists*8hrs/day*5days/wk*16 wks*$60/hr=$76,800 total West Side=$399,000	$ 399,000

RCxM No.	Measure Description	Costing Breakout	Measure Cost
6	**TECHNICAL RCX - NORTH STADIUM FACILITIES** Upgrade controls to DDC, Verify Equipment Functioning and Control, Adjust HVAC Schedules and Setpoints to Needs	$50k/Ahu for DDC NE (8,9,10)=$50,000*3=$150,000 Tech RCx visit: 3 people for 8hr/day*5days/wk*30wks*$60/hr=$216,000 $35,000 parts 2 DDC specialists*8hrs/day*5days/wk*20 wks*$60/hr=$76,800 total North Side=497,000	$ 497,000
7	**ROLLER DOORS IN WEST GREAT HALL**	8 hrs to assess options and choose products2 $60/hr two doors @ $6K + 4 sensors @$1k + 2 carpenters for 1 day +1 electrician for 1 day =24hr*$60/hr + 4 remote openers @ $300/opener	$ 19,120
8	**WEST GREAT HALL (WGH) PRESSURE REVIEW, VFDs ON EXHAUST FANS**	The four motors include two 1.5HP motors, one 5HP motor and one 7 HP motor. RS Means Mechanical Cost Data 2016 lists the following installed costs for VFDs: 5HP: $3,325 7HP: $3,500 It is assumed that the 1.5HP motors would cost $1,000 each. Investigation:2 people*8hrs/day*10days*$60/hr=$9600 $1000 parts 4 BAS points @$1500/point	$ 25,425

ECRM No.	Measure Description	Costing Breakout	Measure Cost
1	**Upgrade MV Lighting to LED**	Stands and ramps: 150 (30W) Canopy fixtures@ ($120/fixture+2.5hrs labor *$55/hr)=$38,625 Towers: 180 (30W) Canopy fixtues w/ photocell @($150/fixture +2.5hrs labor *$55/hr)=$51,750 East Great Hall: 78 (150W) LED HighBay fixtures @($350/fixture+2hrs labor*$55/hr)=$35,880	$ 126,255
2	**Upgrade Older Cooling Equipment** (3 Dx units)	35 ton @ $1400/ton	$ 49,000
3	**Schedule Refrigeration and Ice Machines**	Inventory and procedure development: 2 people*2 weeks*40hrs/wk*$60/hr BAS sensors and control for 8 walk-ins @ $4K each BAS sensors and control to 37 concessions with 1 kill point @$1500 BAS interface @$8k Refined energy analysis for incentive application: 1 person*8hrs*$60/hr	$ 105,580