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30 July 2010

**California Energy Commission**  
**Attn.: ACM Nonresidential Certification**  
**1516 Ninth Street, MS-26**  
**Sacramento, CA 95814-5512**

**California Energy Commission**  
**Attn.: Executive Director**  
**1516 Ninth Street, MS-39**  
**Sacramento, CA 95814-5512**

Sirs:

This letter is to acknowledge the shipment of the completed application package for eQUEST and D2comply hereby submitted for full approval and certification as an Alternative Calculation Methods (ACM) to be used to demonstrate compliance with the Energy Efficiency Standards for nonresidential buildings as specified in Title 24, Part 1, Chapter 10, Section 10-110 of the California Code of Regulations. This application is a revised version of the original application, submitted on December 23, 2009. In the last several months, CEC staff reviewed the application and software and made several requests for revisions. We have completed those revisions and now are submitting a revised application.

James J. Hirsch & Associates (JJH), a sole proprietorship (DBA for James J. Hirsch), has assembled this package for your review and approval in accordance with the requirements set out in the publication "NONRESIDENTIAL ALTERNATIVE CALCULATION METHOD (ACM) MANUAL for the 2008 BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS" with its various updates, references and appendices. The submitted package includes:

- ACM Vendor Certification Statement (in hardcopy, on CD in PDF format, and via ftp download site in PDF format)
- Computer Runs (on CD and via ftp download)
- Compliance Supplement and User's Manuals (included in the eQUEST on-line help documents.)
- Copy of the ACM and Weather Data (on CD and as freeware downloadable from our website)
- CEC supplied Weather Data (included in ACM on CD and from website)

You will note that three of the ACM Certification Tests fall outside of the specified compliance margins specified in the ACM Manual. We believe these differences are due to fundamental improvements in accuracy of the ACM compared to the Commission's reference program and do not believe this should prevent certification of eQUEST and D2Comply.

The eQUEST and D2comply programs, as submitted, are available to the public as freeware. They can be downloaded from our website (<http://DOE2.com>) at no charge. User training and support is also available. If, after eQUEST/D2comply is certified, the Commission desires to obtain the right to distribute the packages to the public at no charge we would be pleased to make that possible.

The JJH team looks forward to the completion of the certification process by the CEC. If any questions arise please contact us.

Cordially

James J. Hirsch

# eQUEST<sup>®</sup> 3.64 AND D2COMPLY 3.64 (DOE-2.2 BASED PROGRAMS) **ACM Certification Application**

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## Sections Contained in this Application

- ACM Vendor Certification Statement
- 1 - Summary of Application
- 2 - CEC Defined Minimum Capabilities
- 3 - CEC Defined Optional Capabilities
- 4 - ACM Certification Test Results

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CALIFORNIA ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

APPLICATION FOR APPROVAL OF A VENDOR-CERTIFIED ALTERNATIVE CALCULATION METHOD  
FOR USE IN DEMONSTRATING COMPLIANCE WITH THE NONRESIDENTIAL BUILDING ENERGY  
EFFICIENCY STANDARDS PER SECTION 141, TITLE 24  
OF THE CALIFORNIA CODE OF REGULATIONS

Part I: General Information

1. Organization filing application:

Name: James J. Hirsch & Associates Phone: ( 805 ) 553-9000  
Address: 12185 Presilla Road  
Camarillo, CA 93012-9243

2. Name of person responsible for completion of this application:

Name: Kevin Madison c/o Madison Engineering, P.S. Phone: ( 206 ) 834-0002  
Address: 444 NE Ravenna Blvd., Suite 406  
Seattle, WA 98115

3. Name, Date, and Version of the Alternative Calculation Method (ACM):

Name: eQuest and D2comply Date: July 30, 2010  
Version: 3.64 (eQUEST) and 3.64 (D2comply)

4. Has a previous version of this ACM ever been certified?

YES       NO

5. Has this ACM been previously submitted for approval or certification?

YES       NO

6. Has this ACM ever been used to analyze the energy use of a building in California?

YES       NO

7. Has this ACM ever been used to determine compliance with the energy efficiency standards of California?

YES       NO

## VENDOR CERTIFICATION OF ALTERNATIVE CALCULATION METHOD

I/We, James J. Hirsch, certify that the alternative calculation method (ACM), herein designated  
 name

eQUEST, version 3.64, dated 7/29/2010, occupying 3,047,482 (3,051,520 on disk)  
 name of alternative calculation method      version      last saved update      exact memory size in bytes

and

D2comply.exe & DOE2Com.dll, version 3.64, dated 7/29/2010 (D2comply), occupying 36,864 (D2comply)  
 name of alternative calculation method      version      last saved update      exact memory size in bytes

conform to all of the requirements specified for an ACM for Commission approval listed in the Nonresidential ACM Approval Manual. I/We specifically certify that this ACM successfully conforms to the test criteria for each and every ACM capability test in Chapter 4 of the Alternative Calculation Method (ACM) Approval Manual for the Nonresidential building energy efficiency standards. Moreover, I/we certify that, to the best of my/our knowledge and belief, we have found no instances where this ACM would indicate compliance for a proposed building that the reference computer program using the reference method would indicate fails to comply with the building energy efficiency standards.

I/We also understand that all required inputs must be available in any approvable ACM but the ACM is not required to model the features described by a given set of inputs. I/We stipulate that this ACM gives the user access to the required inputs and that this ACM automatically warns the user when building inputs use features that the ACM cannot model with sufficient accuracy and automatically fails the proposed building by a margin sufficient to meet the test criteria for any test of that capability.

Signed:

Date: 30 July 2010

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## Summary of Application

### PRODUCTS SUBMITTED FOR CERTIFICATION

The team would like to have the following software packages certified for compliance:

1. **eQUEST:** This is a full Title 24 compliance analysis package including both Building Creation Wizard and Detailed User Interface, DOE-2 simulation and property defaulting, compliance analysis capabilities and compliance form production.
2. **D2Comply:** This includes a version of DOE-2 in the form of an executable (.DLL) files and a compliance ruleset in the form of an encrypted binary (.BIN) file that are supportable using an interface written Visual Basic® or other interface capable of interacting with a Component Object Model (COM). All simulation and compliance analysis components included in this package are compiled from the same source code files as similar components included with eQUEST. Within reasonable testing time constraints, this package yields identical results to eQUEST. The package includes all components necessary for simulation, defaulting, compliance analysis and compliance form production.

The D2Comply package allows third parties to develop unique interfaces for creating DOE 2 input files and performing compliance analysis. Once these software combinations are certified by the Commission, any third party who uses one of the combinations in their ACM, would not need to perform the ACM tests to achieve certification of their ACM. (There are other requirements for certification such as user documentation, software support and compliance supplement that would have to be addressed by any third party ACM developer.)

### PERIODIC UPDATES

The team makes periodic revisions to DOE-2 and the compliance analysis ruleset. Rarely do these revisions affect simulation results. Most are "bug-fixes" that improve the functionality and reliability of the program and do not impact results. Revisions of this type are usually denoted with a letter/number combination at the end of the version number (e.g.: DOE 2.2 Version 47f). The team proposes that these periodic revisions be made available to users, third party developers and the Commission as certified revisions without having to be completely re-certified. We will provide the Commission with advanced notice and copies of software revisions prior to any general releases.

The software version number (DOE-2 or compliance analysis ruleset) will be incremented if any software revisions cause significant changes in simulation or compliance analysis results. In these cases, the team will submit a new ACM Application for the streamlined approval as allowed in Section 1.2.2 of the ACM Manual.

## OVERVIEW OF EQUEST COMPLIANCE ANALYSIS

The underlying concept of the eQuest/DOE 2.2 Title 24 compliance analysis feature is to enable users to generate performance compliance documentation for any building file created and analyzed using DOE 2.2. At this time, the team has submitted for approval only a portion of the DOE 2.2 simulation capabilities. The capabilities to be covered in the application include:

- 1) minimum capabilities of any ACM,
- 2) some pre-defined optional capabilities covered by the ACM Manual, and
- 3) a small number of "vendor-defined" optional capabilities that are submitted along with vendor-developed certification tests.

A critical issue to this ACM is how the ruleset handles features not explicitly addressed as part of our application, are not explicitly addressed in the ACM Manual, and are not being submitted as minimum or optional capabilities under this application. Equally critical to the team is being able to facilitate compliance analysis for nearly any user created DOE 2 input file. In many cases, the ruleset will automatically remove, replace or modify user-defined components and features that are not explicitly addressed in the application or the ACM Manual. In most cases, warning messages are posted so users are aware of building features that will not be considered in the compliance analysis. These "unavailable" features are documented in the eQUEST Compliance Supplement and the DOE 2.2 California Compliance Addenda, included with this application. Consistent with ACM Manual requirements, all DOE 2.2 inputs that are not necessary or inappropriate for simulation of capabilities included with this application are automatically set to DOE 2 defaults by the compliance analysis ruleset.

## CEC DEFINED OPTIONAL CAPABILITIES

This application covers all optional capabilities defined in the ACM Manual **EXCEPT THOSE LISTED IN THE TABLE BELOW:**

ACM Section	Capabilities Excluded from this Application
3.1.1 Additions and Alterations	Alterations
3.1.2 Alteration or Addition Plus Altered Existing	All
3.3.5 Proposed System Types	<ul style="list-style-type: none"> <li>• Underfloor systems</li> <li>• Convective/radiant</li> <li>• Constant volume perimeter systems</li> </ul>
3.3.7 Equipment Efficiency	Performance curve inputs for heating and cooling equipment. The compliance analysis ruleset will reset any user inputs to DOE-2 default performance curves.
3.3.15 Renewables	Solar Thermal Energy
3.3.17 Underfloor Systems	No UFAD compliance capabilities

<b>ACM Section</b>	<b>Capabilities Excluded from this Application</b>
3.3.18 Thermal Storage	No thermal energy storage compliance capabilities
3.3.19 Distributed Storage	No distributed thermal energy storage

In some cases, the CEC's reference program is not capable of properly simulating certain optional capabilities defined in the ACM Manual. These capabilities are discussed in more detail in Section 3 and are listed below:

- Variable speed, centrifugal chillers



## CEC Defined Minimum Capabilities

### INTERMITTENT FAN OPERATION

Section 2.5.3.3 of the ACM Manual requires that fan operation for systems serving residential and hotel guest room occupancies be simulated using INDOOR-FAN-MODE = INTERMITTENT. Unfortunately, the INDOOR-FAN-MODE keyword is not available for many systems in DOE 2.1E, four-pipe fan coil (FPFC) in particular. The ACM certification test that includes residential occupancies (C22C16) utilizes FPFC systems, therefore it is impossible for the CEC's reference program to simulate this test according to ACM Manual requirements.

EQUEST and DOE 2.2 have the capability to simulate intermittent fan operation in many systems including fan coils and other constant volume single zone systems. The eQUEST version of test C22C16 uses intermittent fan operation in both the proposed and standard design simulations as required by the ACM Manual. The result of this difference in program capabilities is that the DOE 2.1E version of the tests shows substantially more fan energy use. More importantly, the eQUEST version of this test complies while the DOE 2.1E version fails by a large margin.

## CEC Defined Optional Capabilities

### VARIABLE SPEED CHILLERS

Test O64B12 specifies an optional capability test for “Variable Speed Drive (VSD) Chiller modeled with an EIR of 0.2275. Review of the DOE 2.1 reference file provided by CEC staff, O64B12.DOE, showed that no input keywords were included in the file for the chillers, making simulation and comparison of the eQUEST/DOE 2.2 capabilities to the reference program impossible.

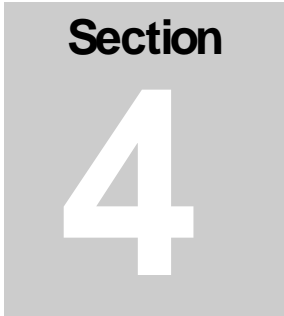
Variable Speed Drive chillers can be simulated in DOE 2.2 through the assignment of appropriate performance curves that account for the temperature difference between entering condenser temperature, ECWT, and leaving evaporator temperature, LChWT (also referred to as “lift”). This capability is only available for centrifugal chillers.

From the DOE 2.2 Dictionary:

“Part-load capacity reduction in a variable-speed centrifugal chiller utilizes a combination of impeller speed and inlet vanes. To maximize the part-load efficiency of a variable-speed centrifugal chiller, some form of condenser temperature relief must be employed at part-load to reduce the temperature (and pressure) differential across the chiller. Otherwise, the performance of a variable-speed chiller may not be significantly different from that of a constant-speed chiller. This is because the pressure rise across the impeller is proportional to the square of the impeller’s speed. If the condenser temperature never drops below the design value, then the pressure differential between the evaporator and condenser will remain almost constant, no significant impeller speed reduction will be possible, and most of the capacity reduction will be accomplished via the inlet vanes.”

Given these considerations, below is a description of test provided for a variable-speed chiller:

- 10 zone B building prototype with the same features (except as noted) in test F14B13
- HVAC system features as described in the ACM Manual Appendix test O64B12
- Centrifugal chiller with capacity and efficiency as specified in the ACM Manual Appendix for test O64B12
- Chiller type in the Compliance subtab of the Chiller tabbed dialog set to “Centrifugal”
- DOE 2.2 chiller property, VARIABLE-SPEED, set to “YES”
- Temperature reset controls simulated on condenser water loop to enable chiller condenser temperature and pressure relief as discussed above
- Cooling tower setpoint of 65F to allow for condenser water temperature drop as wetbulb temperature decreases



# ACM Certification Test Results

Test	PTa	STa	DTa	PTr	STr	DTr	CR1	CR2	LITEr	RECPr	CR3	CR4
A11A09	330.3	336.8	-6.5	327.2	333.3	-6.1	n/a	1.5	106129.0	61569.2	1.00	1.00
A12A09	432.7	435.0	-2.3	425.7	438.9	-13.1	n/a	13.8	106129.0	61569.2	1.00	1.00
A21B13	370.1	280.8	89.3	363.2	284.5	78.8	23.4	n/a	56445.9	80197.0	1.00	1.00
A22B13	280.5	243.6	36.9	282.6	243.7	38.9	4.8	n/a	56445.9	80197.0	1.00	1.00
A23B06	263.9	237.9	25.9	248.6	233.2	15.4	13.9	n/a	63556.3	90868.0	1.00	1.00
A24B16	269.4	223.9	45.5	279.4	231.4	48.0	5.7	n/a	57391.8	81209.9	1.00	1.00
A25B03	313.4	234.2	79.2	310.5	239.8	70.7	20.1	n/a	56659.1	80637.7	1.00	1.00
A26B13	362.2	280.8	81.4	356.1	284.5	71.6	21.5	n/a	56445.9	80197.0	1.00	1.00
A27B16	257.5	224.2	33.3	265.3	231.1	34.2	5.3	n/a	57391.8	81209.9	1.00	1.00
B11B13	486.8	464.6	22.3	485.2	460.8	24.4	2.5	n/a	173266.1	85948.9	1.00	1.00
B12B13	491.4	471.3	20.2	489.8	467.7	22.1	2.4	n/a	173266.1	85948.9	1.00	1.00
B13B13	518.0	474.3	43.7	515.1	469.0	46.1	5.5	n/a	173266.1	85948.9	1.00	1.00
B14B06	464.3	442.0	22.3	443.9	427.8	16.1	9.6	n/a	195219.5	96866.6	1.00	1.00
B15B16	447.2	411.6	35.6	454.0	415.3	38.6	3.8	n/a	173406.0	86098.4	1.00	1.00
B21B12	460.4	438.0	22.5	461.9	434.8	27.1	0.4	n/a	173210.7	86002.0	1.00	1.00
B22B12	457.3	438.0	19.3	458.5	434.8	23.6	0.2	n/a	173210.7	86002.0	1.00	1.00
B23B12	428.9	439.9	-11.0	428.1	436.3	-8.2	n/a	-0.6	173210.7	86002.0	1.00	1.00
B24B03	367.3	385.5	-18.1	357.1	375.6	-18.6	n/a	4.2	173311.1	86002.3	1.00	1.00
B31D12	562.1	471.6	90.5	563.6	478.1	85.5	18.8	n/a	173210.7	86002.0	1.00	1.00
B32D12	582.7	471.6	111.2	583.5	479.0	104.5	23.4	n/a	173210.7	86002.0	1.00	1.00
C11A10	448.8	414.7	34.1	440.5	417.8	22.7	15.8	n/a	106400.7	61632.9	1.00	1.00
C12A10	446.6	419.8	26.8	438.7	418.7	20.0	10.7	n/a	90524.3	53284.2	1.00	1.00
C13A10	508.1	490.0	18.1	497.2	480.8	16.4	5.2	n/a	100876.2	36343.1	1.00	1.00
C14A10	421.7	370.4	51.4	414.8	373.1	41.7	16.9	n/a	75732.7	79791.5	1.00	1.00
C15A10	373.7	311.4	62.3	367.2	314.2	53.0	18.3	n/a	44358.5	67905.9	1.00	1.00
C21B10	337.3	292.6	44.7	315.4	289.1	26.3	23.3	n/a	85884.2	80395.9	1.00	1.00
C22C16	199.0	191.9	7.1	251.1	220.2	30.9	-18.1	n/a	65355.5	39108.1	1.00	1.00
D11D12	440.2	443.4	-3.2	434.2	440.8	-6.6	n/a	5.4	173210.7	86002.0	1.00	1.00
D12D12	464.6	441.7	22.9	458.6	438.9	19.7	7.2	n/a	173210.7	86002.0	1.00	1.00
D13D07	378.0	389.3	-11.3	371.2	381.9	-10.8	n/a	2.1	149693.4	74372.4	1.00	1.00
D14D07	400.2	388.3	11.9	392.9	380.6	12.3	2.4	n/a	149693.4	74372.4	1.00	1.00
E11D16	226.8	149.5	77.3	220.2	147.5	72.7	16.5	n/a	45914.0	26356.6	1.00	1.00
E12D16	239.9	162.1	77.8	231.2	159.2	72.0	17.6	n/a	45914.0	26356.6	1.00	1.00
E13D16	281.7	203.5	78.2	266.2	197.8	68.4	21.0	n/a	45914.0	26356.6	1.00	1.00
E14D14	242.4	163.7	78.7	237.4	160.7	76.7	14.4	n/a	50651.2	29265.0	1.00	1.00
E15D14	252.1	174.2	77.9	246.2	170.3	75.8	14.5	n/a	50651.2	29265.0	1.00	1.00

Test	PTa	STa	DTa	PTr	STr	DTr	CR1	CR2	LITEr	RECPr	CR3	CR4
E16D14	284.8	208.9	75.9	274.8	202.2	72.7	15.1	n/a	50651.2	29265.0	1.00	1.00
E21B16	324.0	259.4	64.7	333.0	261.4	71.6	4.8	n/a	57394.5	111569.7	1.00	1.00
E22B16	354.2	291.0	63.2	362.4	292.5	69.9	4.8	n/a	57394.5	141937.1	1.00	1.00
E23B16	415.4	355.2	60.2	422.4	355.6	66.8	4.5	n/a	57394.5	202657.1	1.00	1.00
E24B12	327.9	268.1	59.7	328.2	265.9	62.3	7.8	n/a	57170.8	110944.9	1.00	1.00
E25B12	360.3	302.6	57.7	360.3	300.2	60.1	7.6	n/a	57170.8	141142.3	1.00	1.00
E26B12	426.3	372.4	53.8	425.7	369.7	56.0	7.3	n/a	57170.8	201522.3	1.00	1.00
F11A07	329.4	295.2	34.2	320.1	297.2	22.9	15.7	n/a	57952.1	62996.9	1.00	1.00
F12A13	397.5	373.8	23.7	387.6	371.1	16.5	10.6	n/a	63806.9	70476.8	1.00	1.00
F13B12	429.8	429.3	0.5	425.6	424.3	1.3	0.4	n/a	173210.7	86002.0	1.00	1.00
F14B12	429.3	428.8	0.5	425.2	423.9	1.3	0.4	n/a	173210.7	86002.0	1.00	1.00
F15A01	236.9	179.5	57.5	239.4	185.9	53.5	13.0	n/a	45770.1	26291.1	1.00	1.00
G11A11	413.5	360.2	53.4	397.9	358.5	39.4	20.9	n/a	64708.5	70979.4	1.00	1.00
G12A11	393.4	359.5	33.9	390.0	366.4	23.6	14.8	n/a	64708.5	70979.4	1.00	1.00
G13A11	415.1	361.4	53.7	406.9	361.8	45.1	16.4	n/a	64708.5	70979.4	1.00	1.00
G14A11	391.6	358.9	32.7	390.7	368.8	21.9	15.0	n/a	64708.5	70979.4	1.00	1.00
G15B03	211.1	202.1	9.0	211.7	197.1	14.6	-2.4	n/a	56661.7	80636.9	1.00	1.00
G16B16	257.7	234.3	23.4	261.6	239.6	22.0	5.7	n/a	57394.5	81209.0	1.00	1.00
O11B13	441.5	385.9	55.6	442.6	382.0	60.5	5.1	n/a	173267.9	86048.0	1.00	1.00
O12B13	497.2	385.9	111.2	499.7	382.0	117.6	12.2	n/a	173267.9	86048.0	1.00	1.00
O21B13	573.9	449.8	124.1	572.4	442.3	130.2	14.5	n/a	173266.1	85948.9	1.00	1.00
O22B13	613.7	449.8	163.9	611.7	442.3	169.4	20.8	n/a	173266.1	85948.9	1.00	1.00
O23B13	519.0	449.8	69.2	518.2	442.3	76.0	5.6	n/a	173266.1	85948.9	1.00	1.00
O24B13	516.3	449.8	66.5	511.0	442.3	68.7	9.1	n/a	173266.1	85948.9	1.00	1.00
O31A12	396.9	371.3	25.5	392.2	365.9	26.3	4.2	n/a	95438.9	54817.1	1.00	1.00
O32A12	400.3	371.3	29.0	388.6	365.9	22.7	10.7	n/a	95438.9	54817.1	1.00	1.00
O33A12	394.8	371.3	23.5	386.1	365.9	20.2	7.4	n/a	95438.9	54817.1	1.00	1.00
O41B13	498.3	482.0	16.3	458.4	439.9	18.5	1.6	n/a	173266.1	85948.9	1.00	1.00
O61B12	701.8	426.4	275.4	671.5	407.2	264.3	51.7	n/a	173210.7	86002.0	1.00	1.00
O62B12	620.8	426.4	194.4	586.4	407.2	179.2	43.0	n/a	173210.7	86002.0	1.00	1.00
O63B12	560.1	426.4	133.7	526.9	407.2	119.8	32.9	n/a	173210.7	86002.0	1.00	1.00
O65B12	530.8	426.4	104.4	521.2	407.2	114.0	8.5	n/a	173210.7	86002.0	1.00	1.00
O66B12	527.2	416.8	110.4	522.8	408.4	114.4	14.1	n/a	173210.7	86002.0	1.00	1.00
O71B12	417.1	307.4	109.7	428.1	309.7	118.5	10.0	n/a	95439.5	54827.3	1.00	1.00
O81A11	403.4	373.3	30.1	396.9	365.7	31.3	4.5	n/a	95564.2	54827.3	1.00	1.00
O82A15	517.1	471.5	45.6	510.9	463.0	47.8	6.0	n/a	106148.1	61431.8	1.00	1.00
O91A13	439.5	402.3	37.3	423.2	396.0	27.2	15.2	n/a	94233.0	54438.3	1.00	1.00
O92A11	401.6	382.9	18.8	393.0	381.7	11.3	10.1	n/a	95564.2	54827.3	1.00	1.00

Test	PTa	STa	DTa	PTr	STr	DTr	CR1	CR2	LITEr	RECPr	CR3	CR4
O93A12	404.2	369.6	34.6	401.2	382.9	18.3	20.0	n/a	95438.9	54817.1	1.00	1.00
O94A13	420.3	393.9	26.4	411.8	393.6	18.2	12.0	n/a	94233.0	54438.3	1.00	1.00

\* Indicates results do not fall within the prescribed tolerance. Note that ACM pass/fail results match the reference program results. However these three ACM tests either pass by too much or fail by too little compared to the reference program.