

INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1847-TRP, “Updating climatic design information for the 2021 ASHRAE Handbook, Standard 169, and the Handbook of Smoke Control Engineering”

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: TC 4.2, Climatic Information

Co-sponsored by: TC 4.1, Load Calculation and Procedures, TC 5.6, Control of Fire and Smoke

Budget Range: \$150,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: April 1, 2019 or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EST, December 17, 2018. NO EXCEPTIONS, NO EXTENSIONS. Electronic copies must be sent to rpbids@ashrae.org. Electronic signatures must be scanned and added to the file before submitting. The submission title line should read: 1847-TRP, “Updating climatic design information for the 2021 ASHRAE Handbook, Standard 169, and the Handbook of Smoke Control Engineering”, and “*Bidding Institutions Name*” (electronic pdf format, ASHRAE’s server will accept up to 10MB)

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters

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For Administrative or Procedural Matters:

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Contractors intending to submit a proposal should so notify, by mail or e-mail, the Manager of Research and Technical Services, (MORTS) by December 3, 2018 in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.

All proposals must be submitted electronically. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **ALL electronic proposals are to be sent to rpbids@ashrae.org.**

All other correspondence must be sent to ddaniel@ashrae.org and mvaughn@ashrae.org. Hardcopy submissions are not permitted. **In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EST, December 17, 2018. NO EXCEPTIONS, NO EXTENSIONS.**

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

- (1) ASHRAE Application for Grant of Funds (electronic signature required) and
- (2) Additional Information for Contractors (electronic signature required) ASHRAE Application for Grant of Funds (signed) and

ASHRAE reserves the right to reject any or all bids.

State of the Art (Background)

Chapter 14 of the ASHRAE Handbook – Fundamentals provides climatic information in support of design and sizing methods found in other chapter of the Handbook, such as *Fenestration* (ch. F-15), *Ventilation and Infiltration* (ch. F-16), *Residential cooling and heating load calculations* (ch. F-17), *Nonresidential cooling and heating load calculations* (ch. F-18), *Energy estimating and modeling methods* (ch. F-19), *Airflow around buildings* (F-24), and others. It also provides the data used in *ASHRAE Standard 169*, the *ASHRAE Handbook of Smoke Control Engineering*, and the *Weather Data Viewer*.

The 2017 edition of the Handbook – Fundamentals includes data for 8,118 stations worldwide. Roughly two thirds of these stations are located outside of North and Central America, illustrating in a very concrete way the international orientation of ASHRAE. Over the last five editions of the Handbook, successive research projects have increased the number of stations by 550%. This increase in the *quantity* of stations enables to use data for locations closer to where building projects are actually located.

Over the same period, the *number of elements* listed in the tables has grown from fewer than 50 to over 500. In part this reflects changes in design methods, in particular the use of monthly, rather than annual, design conditions which enable a more accurate sizing of HVAC equipment; but also the addition of new elements (monthly clear-sky and all-sky solar irradiance, precipitation and wind speed, among others) used in design methods and in green building technologies.

In parallel, the *quality* of the data has increased. The wider availability of climate records in electronic form, and improved quality control methods developed by successive research projects, have enhanced the consistency, reliability and completeness of the design data provided in the Handbook.

Finally, the period of record has also changed. In the past, the design conditions were calculated using the most recent data sets without regard to the length of record. It was assumed that more years resulted in less uncertainty due to lower sampling errors, assuming a stationary climate. However climate change is resulting in a generally warming climate, so the approach adopted by TC 4.2 (the TC responsible for Chapter 14) was that the climatic values should be updated in concert with the Handbook update cycle, with the most recent 25 years of data (from 1990 to 2014 for the 2017 Handbook - Fundamentals edition). This enables the climatic design elements to reflect recent changes in the climate. This is a fairly unique situation for ASHRAE and its members. The 4-year update cycle supports both the mitigation of climate change (to the degree that optimizing the accuracy of design procedures supports energy efficiency) and the adaptation to the ongoing changes in climate. In addition, the last two research projects that updated the climatic design conditions in the Handbook have calculated long-term trends in average and design temperatures, degree-days, and other variables. These studies, available in the research reports and summarized in Ch. 14 of the Handbook, confirm the evolution of the climate, with significant regional variations.

Justification and Value to ASHRAE

The climatic design conditions in Chapter 14 of the Handbook - Fundamentals are essential for the sizing and design of building energy systems. This latest update will allow for optimal energy efficiency measures and ensure that the design conditions are related to the energy system capacity to meet the climatic loads in a probabilistic sense.

This latest update will:

- Serve the membership by providing up-to-date data in support of sizing and design methods for building energy systems. Regular updating of the climatic conditions is critical in this respect for many practical reasons and to show due diligence in a world of changing climate;
- Allow more local climatic design conditions to be used when designing building energy systems, by increasing the geographical density of the stations listed in the Handbook;
- Keep ASHRAE at the forefront of the delivery of climatic design information in support of energy design, energy efficiency, green buildings and net zero energy buildings.

In addition, this research project will provide data in support of the Handbook of Smoke Control Engineering and of Standard 169.

Objectives

The specific objectives of this project are to:

1. Recalculate climatic design conditions for Chapter 14 of the Handbook - Fundamentals, which will require obtaining the most recent hourly weather observations for the period 1994-2018 from NOAA and Environment Canada for global locations, with spatial distribution covering all continents and countries to the greatest extent possible as allowed by the climatic data available. Unless directed by the PMS, all parameters in the 2017 edition will be included in the 2021 update.
2. Provide an analysis of climatic trends (means and extremes) of temperature and moisture (using an appropriate statistical method) for each location, as provided in the 2013 and 2017 Handbook – Fundamentals. Provide ways to report that information, on a per-station and/or regional basis, along with the climatic design data in the Handbook. Research and implement the development of indicators for future climate, on a per-station and/or regional basis, which can assist engineering in designing building for the climate of the future.
3. Update the clear-sky coefficients if required, based on updated analysis of remotely sensed aerosol data.
4. Add new elements such as prevailing wind information, including percent of the month that the most frequent wind directions occur, and mean and median speed of the prevailing winds, in support of the Handbook of Smoke Control Engineering, and the Weather and Shielding Factor (WSF) in support of Standard 169. Also, based on input from the PMS, additional elements/parameters may be considered for inclusion, if they are within the scope of the project and within the allotted budget.
5. Provide material for inclusion in Chapter 14 of the Handbook – Fundamentals, and future versions of Standard 169:
 - Updated tables of climatic design information for all stations with sufficient period of record;
 - Elements in support of updating the text of the chapter itself;
 - Climate zones maps for Standard 169.
6. Update the Weather Data Viewer with the same stations and climatic design information as the Handbook, and prepare a new, web-based version of the Weather Data Viewer.
7. Provide tables of climatic design information specific to the ASHRAE Handbook of Smoke Control Engineering.
8. Prepare electronic information products containing the data in the format required for publication in the 2021 Handbook, the Weather Data Viewer, Standard 169, and the Handbook of Smoke Control Engineering, in consultation with the PMS.
9. Prepare publications to disseminate the information about this research.

Scope:

The project will be supervised by a Project Monitoring Subcommittee (PMS) of TC 4.2, TC 4.1 and TC 5.6.

Task 1:

Obtain the most recent hourly weather observations for the period 1994-2018 from NOAA and Environment Canada for locations around the world. Also obtain supplementary information suitable for compiling precipitation-related design conditions (for the 2017 Handbook, sources such as the Global Historical Climatology Network (GHCN), FAOClm-Net, the Global Precipitation Climatology Centre (GPCC), and the Global Precipitation Climate Project (GPCP) were used, although other sources may be considered). Finally, obtain supplementary information suitable for calculating or compiling all-sky solar radiation data as present in Ch. 14 of the Handbook – Fundamentals. Notify and confirm with the PMS that the required data have been obtained.

Task 2:

Calculate temperature trends, using a method similar to that used for the 2017 Handbook, and/or use a compilation from published sources such as the IPCC, to provide past and anticipated temperature trends on a regional and/or station-by-station basis. In collaboration with the PMS, propose ways to incorporate that information in the Tables

of Climatic Design Conditions in the Handbook, in a manner that is both practical and easily understandable by the membership.

Task 3:

Update climatic design conditions according to algorithms used for the 2017 Handbook of Fundamentals as described in the ASHRAE 1699-RP Final Report, *Update Climatic Design Data in Chapter 14 of the 2017 Handbook of Fundamentals* (Roth, 2016). This includes:

- Recalculating temperature, humidity (dew-point, wet-bulb, etc.), wind and other design conditions for all locations with sufficient period of record;
- Compiling or calculating precipitation and all sky solar radiation for the same locations;
- Updating the clear-sky coefficients to reflect the state of the art in the estimation of aerosol loadings and other atmospheric constituents influencing clear sky solar radiation;
- Developing methods to calculate new elements such as those required by the *Handbook of Smoke Control Engineering* and Standard 169;
- Responding to reasonable requests from the PMS to incorporate new elements not foreseen at the writing of this work statement.

Provide an interim report to the PMS regarding the data, including the number of stations available with adequate data and any issues found thus far. Software used for the 2017 Handbook – Fundamentals Chapter 14 is available from ASHRAE for use in preparing the 2021 updates. Modification of this software or development of additional software will be needed to produce the data elements for 2021. The contractor should make a royalty-free copy of the updated software available to ASHRAE after the project, so that it can be used for processing data in future versions of the Handbook. It is envisioned that the current number of locations (8,118) will increase to at least 9,000 globally. In addition, including the most recent observational data will provide a better indication of climatic trends and appropriate design conditions for all locations.

Task 4:

Prepare tables and other electronic files with the appropriate data for the 2021 Handbook update, Standard 169, and the Handbook of Smoke Control Engineering in paper format, DVD, online and other electronic formats. It is anticipated that the full tables will be produced as individual PDF files (both SI and IP units) with a subset of the elements available for selected stations in the paper edition of the Handbook. Excel or csv files with all the data for all stations will also be required. The contractor will provide sample tables in draft format for approval by the PMS. The contractor will be expected to respond to requests from the PMS for small changes or additions to the format of the tables. The contractor will also provide a Google map interface to find locations with data and link to all locations' data provided in the on-line version of the Handbook. This interface is to be hosted by ASHRAE as part of the on-line Handbook.

Task 5:

In collaboration with SSPC 169, provide updated climate zone maps in a format which can be easily imported into Standard 169 and other documents as required.

Task 6:

Provide a completed update to the Weather Data Viewer 6.0. While the primary data of the Chapter 14 tables comprise near-extreme selected annual and monthly percentiles of primarily temperature and humidity conditions, this product provides the full single and joint frequency distributions of all the parameters. All previous versions of the Weather Data Viewer were available on CD or DVD. It is expected that the next version resulting from this present Research Project will be available only as an on-line product available by subscription from ASHRAE. The contractor is expected to develop the web application that will provide the same functionalities as previous versions of the Weather Data Viewer, using a web technology approved by the PMS and ASHRAE. ASHRAE will be in charge of hosting this application. As part of this task the contractor is also invited to propose ways of making the climatic design conditions data available via standard web service APIs so data could be retrieved via software for use, or mashing up, with other services.

Task 7:

Final Report and Technical Paper. The contractor will prepare a complete final report documenting project results. A technical paper suitable for publication in ASHRAE Transactions will also be prepared.

The completion of each intermediate deliverable will be reviewed and approved by the PMS before the project proceeds to the next task.

Deliverables:

Progress, Financial and Final Reports, Technical Paper(s), and Data shall constitute the deliverables (“Deliverables”) under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Institution’s Principal Investigator, subject to the Society’s approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. For tasks 1-6 above:

1. Task 1: Notify and confirm with the PMS that the required data for the project have been obtained. Include a report of any issues or problems encountered and an outline of the project plan.
2. Task 2: Provide the PMS with a short interim report with the finding of this task. Propose to the PMS ways to incorporate the results of this research in the Tables of Climatic Design Conditions in the Handbook.
3. Task 3: As the climatic design data are being prepared, provide an interim report to the PMS regarding the data, including the number of stations available with adequate data and any issues found thus far, along with an update of the project plan detailing the schedule for deliverables.
4. Task 4: Provide to the PMS sample tables in draft format (samples include individual PDF files, tables for the printed edition of the Handbook, tables in Excel format, and others as appropriate). Provide a prototype of the Google Maps interface. The PMS will provide feedback and the contractor will respond with any requested changes. Then, after any issues are resolved, provide to the PMS the final climatic design data (for all locations) and Google Map interface for Chapter 14 of the Handbook – Fundamentals, Standard 169, and the Handbook of Smoke Control Engineering. Once the processing is complete, provide the PMS with a royalty-free copy of the software used to calculate the climatic design conditions.
5. Task 5: Provide climate zone maps for Standard 169, in a format approved by the PMS.
6. Task 6: Provide the PMS with an interim report proposing a technology appropriate for the development of the Weather Data Viewer. Then, after approval of the technology choice by the PMS and development is complete, provide the PMS with all code, databases, etc. necessary for deployment of the application on a third party server.

c. Final Report

A written report, design guide, or manual, (collectively, “Final Report”), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society’s Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement, including a summary of the control strategy and savings guidelines. Unless otherwise specified, the final draft report shall be furnished, electronically for review by the Society’s Project Monitoring Subcommittee (PMS).

Tabulated values for all measurements shall be provided as an appendix to the final report (for measurements which are adjusted by correction factors, also tabulate the corrected results and clearly show the method used for correction).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form suitable for wide distribution to the industry and to the public.
- Two copies; one in PDF format and one in Microsoft Word.

d. *Science & Technology for the Built Environment* or ASHRAE Transactions Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an ASHRAE Transactions Technical or HVAC&R Research papers. The paper title shall contain the research project number (1847-RP) at the end of the title in parentheses, e.g., (1847-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

e. Data

Data is defined in General Condition VI, "DATA"

f. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort

The expected project budget is \$150,000 and anticipated project duration is 24 calendar months, spanning 4 ASHRAE meetings. Effort is expected around 10 full-time equivalent person-months, equally divided between the Principal Investigator and an assistant.

Other Information for Bidders

Responsive proposals will demonstrate familiarity with the data sources and analysis methods required to perform the specified tasks. It is recognized that the possible inclusion of new elements makes the scope of this project somewhat less bounded. Proposals should discuss possible new elements and methods for deriving them. Suggestions about other elements are welcome. At a minimum, proposals should demonstrate that they can thoughtfully evaluate the practicality of including new elements so they can work effectively with the PMS in determining which new elements (if any) should be included as required in Task 3.

Similarly, the inclusion of temperature trends in the tables of climatic design conditions (Task 2) is somewhat tentative at this stage and bidders should demonstrate capability to arrive at a recommendation (this represents the part of the Research Project that will be more research-oriented, as opposed to other tasks which may be more data-processing oriented).

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Obtaining sources of climate data as specified in Task 1	4
2	Calculate temperature trends	10
3	Calculate temperature trends	14
4	Demonstrate prototype Weather Data Viewer	18
5	Final versions of the tables, the Weather Data Viewer, and final report and technical paper	24

Proposal Evaluation Criteria

Proposals submitted to ASHRAE for this project should include the following minimum information:

No.	Proposal Review Criterion	Weighting Factor
1	Contractor's demonstrated understanding of Work Statement as revealed in proposal.	15%
2	Quality of methodology proposed for conducting research.	25%
3	Contractor's capability in terms of facilities and relevant prior research.	15%
4	Qualifications of personnel for this project.	20%
5	Probability of contractor's research plan meeting the objectives of the Work Statement.	25%

References

1. ASHRAE (2012) Handbook of Smoke Control Engineering. ASHRAE Inc., Atlanta, GA. See also <https://www.ashrae.org/resources--publications/bookstore/handbook-of-smoke-control-engineering>
2. ASHRAE (2013) Standard 169-2013, Climatic Data for Building Design Standards. ASHRAE Inc., Atlanta, GA.
3. ASHRAE (2017a) Handbook – Fundamentals. Chapter 14, Climatic Design Information. ASHRAE Inc., Atlanta, GA.
4. ASHRAE (2017b) Weather Data Viewer, version 6. ASHRAE Inc., Atlanta, GA. See also <https://www.ashrae.org/resources--publications/bookstore/climate-data-center#wdv5>
5. Roth M (2016) ASHRAE Research Project 1699-RP, Update Climatic Design Data in Chapter 14 of the 2017 Handbook of Fundamentals. Final Report. Available from ASHRAE Inc., Atlanta, GA.
6. Roth M (2017) Updating the ASHRAE climate design data for 2017. ASHRAE Transactions 123(2).