INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1999-TRP, Updating climatic design conditions for the 2029 ASHRAE Handbook – Fundamentals and ASHRAE Standard 169

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 Design Information
Co-sponsored by: TC 4.1, Load Calculation Data and Procedures

Budget Range: $200,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **September 1, 2026,** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, May 15th, 2026. 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: 1999-TRP, Updating climatic design conditions for the 2029 ASHRAE Handbook – Fundamentals and ASHRAE Standard 169, 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
Technical Contact
Michael Roth
E-Mail: michael.roth@klimaat.ca

For Administrative or Procedural Matters:
Manager Research & Technical Service
Steve Hammerling
ASHRAE, Inc.
180 Technology Parkway, NW
Peachtree Corners, GA 30092
Phone: 404-636-8400
E-Mail: Shammerling@ashrae.org

Contractors intending to submit a proposal must notify the Research Administrator by email no later than May 1, 2026. This notification will ensure that any late or additional information regarding the RFP can be provided prior to the proposal due date. The deadline for submitting technical questions is also Monday, May 1st, 2026.

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. Hardcopy submissions are not permitted. **In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, May 15, 2026.**
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)

ASHRAE has been providing tables of climatic design conditions to its membership, in successive editions of the Handbook dating back to at least the 1950's. These climatic design conditions support a number of calculation methods found throughout 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. Since 2006, the tables of climatic design conditions have also formed the basis of Standard 169, *Climatic Data for Building Design Standards*, a standard that is referenced in other standards such as Standards 90.1, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings, 90.2, High-Performance Energy Design of Residential Buildings, 90.4, Energy Standard for Data Centers, 100, Energy and Emissions Building Performance Standard for Existing Buildings, 189.1, Standard for the Design of High Performance, Green Buildings, and others.

The original tables of climatic design conditions were mostly concerned with sites in the USA and Canada. The tables were later expanded to the rest of the world, in step with ASHRAE's focus on becoming a more international organization. In parallel with this, the digital revolution led to an explosion in the availability of climatic data sources that could be used to calculate design conditions. For example the 2001 Handbook listed 1459 stations, of which 55% were outside of North America. The latest edition (2025) contains 12424 stations, of which close to 70% are outside of North America.

In parallel with an increase in the number of stations, an increase in the quality of the data and the number of climatic conditions were observed. Better outlier detection and quality control techniques were implemented over the years, significantly improving the reliability of the final data presented to the membership; and new climatic conditions (monthly design data, clear sky solar irradiance, etc.) were also added to support new load calculation methods.

During the same time frame, tremendous progress was made in the field of climate modeling through the use of reanalysis models. Model improvements enabled the latest edition of the Handbook to use reanalysis data sets to calculate climatic design conditions in regions with insufficient data. This was done either with a calibrated model (for about 9% of stations with sparse data that could be used for model calibration) or with an uncalibrated model (for about 1% of stations in under-represented areas).

This work also benefits from the increasing availability of high-resolution gridded data for select daily meteorological data such as temperature and precipitation. The gridded data from multiple competing sources was combined through consensus to generate the county map of climate zones for Std 169, a process which used to be done through complicated and subjective manual assignments.

Greater awareness of the impact of climate change on thermal building performance (see for example Duan et al., 2005) has also led to the inclusion of temperature trends in the Handbook. The climatic design conditions chapter therefore aims to provide not only climatic design conditions reflecting the most recent historical data, but also when possible an indication of how these conditions have been trending over time.

Finally, the modes of delivery of the information to the ASHRAE membership has also evolved significantly. Whereas the tables were originally printed in the body of the Climatic Information chapter, they were subsequently made available in electronic (pdf) format, and lately through the online Weather Data Viewer and an Application Programming Interface (API).

Justification and Value to ASHRAE

The climatic design conditions found in Ch. 14 represent an essential part and one of the most often referred-to areas of the Handbook. They are used, directly or indirectly (through Standard 169) in numerous chapters and standards. Keeping these tables up-to-date therefore has an obvious intrinsic value to the membership.

In addition, since the 2021 update (1847-RP) of the Handbook, the Weather Data Viewer has been turned into an online product. It has been accompanied by a data repository for software developers, with associated license to re-use the data in their own applications. These two products have been generating significant revenue for ASHRAE and substantially offset the cost of the research project.

Objectives

The objectives of this project are:

1. Retrieve the hourly data sets used to calculate the climatic design conditions. Hourly weather stations data for the period 2003-2027 (25 years) from the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) and Environment and Climate Change Canada (ECCC) will be used, possibly supplemented by other sources, or data from other periods as available.

2. Update and improve the software used to calculate climatic design conditions. All parameters calculated in the 2025 edition will be included in the 2029 edition. A limited number of new parameters may also be considered for inclusion. Improvements to the software should focus on at least two areas:

a) Outlier detection. The software currently used to calculate the climatic design conditions already employs a mix of robust statistical methods to catch erroneous data; however, machine learning techniques are now able to flag erroneous data based on large vectors of features such as seasonality, time-of-day, other stations, position of sun, etc. The contractor is asked to research and implement such methods in the project.

b) Smoothing and infilling of histograms. The calculation of climatic design conditions relies on data binning, however the resolution of the underlying data interferes with the binning process, leading to some bins that can have very few points or are even empty. The contractor will research and implement methods to smooth these bins.

3. Recalculate climatic design conditions, using the data from Objective 1 and the software from Objective 2.

4. Supplement the data calculated in Objective 1 with data obtained from reanalysis models (see 1900-RP). This can be done in a number of ways, including:

- For stations having some data, but over a period of less than 8 years, calibrate the reanalysis model with measured data, and use the output of the model to calculate climatic design conditions over a longer period of time;
- The same approach can be used for stations having data but outside the desired 2003-2027 target period;
- For few stations having no data at all, use the uncalibrated reanalysis model to calculate climatic design conditions.

5. Update clear-sky coefficients based on the most recently available remotely sensed aerosol, water vapor, ozone, ground albedo and nitrogen dioxide data. Update all-sky solar radiation using the most recently available remotely sensed or gridded data. Finally, update precipitation data using the most recently available gridded data sets and observational data sources, as appropriate.

6. Update calculations of climatic trends: regional trends that include all stations within a certain radius (200 km in the 2025 edition) of a station; and individual station trends.

7. Provide material for inclusion in Chapter 14 of the Handbook – Fundamentals, such as updated tables in pdf format.

8. In coordination with ASHRAE publication staff and IT support, update (a) the "Weather Data Viewer" and its associated API and (b) the "Climatic Design Data License for Software Engineers", both of which have been available in the last editions of the Handbook.

9. Prepare tables and climate zone maps in support of Standard 169.

10. Prepare publications to disseminate the results of this research.

Scope:

The project will be monitored by a Project Monitoring Subcommittee (PMS) with members of TC 4.2 (Climatic Information) and 4.1 (Load Calculation Data and Procedures). Note that all completed tasks need to be approved by the PMS before assembling the final tables of climatic design conditions. While this list indicates the anticipated sequence of Tasks, the success of previous editions of this project has benefited greatly from the Contractor working collaboratively with the PMS, suggesting modifications and improvements to the overall workflow.

Task 1 – Obtain data:

a) Download the most recent climatic data for the period 2003-2027, from NCEI's Global Historical Climatology Network hourly (GHCNh; see Dunn et al., 2016, and NCEI, 2025 in the references) for US and International locations.

b) Obtain similar data from Environment and Climate Change Canada (ECCC) for Canadian locations (contact info will be provided by the PMS).

c) Possibly, supplement the above data sets with data from other sources (such as data provided by national weather services for various countries, although the GHCNh data set should be sufficient for most locations). For a complete list of dataset used to produce the tables in the 2025 Handbook, please see Roth (2025b).

d) See Task 5 below for additional data sources to obtain, such as for precipitation and solar radiation data.

Task 2 – Update software:

a) Update the software to calculate climatic design conditions. The code used for data processing for ch. 14 of the 2025 Handbook – Fundamentals is available from ASHRAE for use in preparing the 2029 edition (see Roth, 2025b). The main processing software is currently written in C++ and maintained through a private Github repository. Driving this main code is an extensive set of Python scripts, GUIs, and libraries. The software will need to be updated or (at the contractor's discretion) rewritten to read new input data from Task 1a above, possibly to calculate new elements as specified by the PMS, and to incorporate new outlier detection and binning methods as specified in Tasks 2b and 2c below. 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.

b) It is desirable to improve the detection of outliers in data fed to the calculation software. Since design conditions represent by definition extreme conditions, it is important to remove outliers that could skew the tails of the distributions of climatic variables. The current version of the processing software already incorporates several statistical methods to detect and eliminate such outliers. However, machine learning techniques have now become widely available, with the ability to recognize deep patterns in the data based on other variables such as seasonality, time-of-day, other stations, position of sun, all available meteorological variances, etc. The contractor will research, test and implement, if warranted, such methods in the software of Task 2a, to improve the quality of the climatic design conditions produced by the software. Key performance indicators, such as the number of false positive and false negatives produced by the detection algorithms, will also be reported.

c) A recurring complaint from users of the Weather Data Viewer has been the jaggedness of some of the histograms produced; that is, histograms may alternate bins with many data points with bins with few if any. This is traceable to the underlying data, for example the lack of precision of the data or the use of different units at the time of recording and processing. One method to alleviate this problem is to implement smoothing techniques based on the work of Whittaker (1922) and documented in Roth (2025b). This technique could be applied either to the original data during processing or as an option in the Weather Data Viewer. The contractor will investigate such techniques, assess their applicability to the types of distributions encountered in the calculation of climatic design conditions, and implement them, if warranted, in the software of Task 2a.

Task 3 – Calculate climatic design conditions:

a) With the data from Task 1 and the software from Task 2, recalculate climatic design conditions such as simple design conditions (e.g. design dry bulb temperatures, dew point temperatures and wet bulb temperatures, etc.) and joint design conditions (e.g. dry bulb temperature coincident with the design wet bulb temperature, or vice-versa, etc.). For a complete list of elements, please consult the 2025 edition of the Handbook – Fundamentals (see ASHRAE, 2025). For reference, the number of locations successfully processed this way in 2025 was 11,266 (out of 12,424 stations in total in the Handbook) and is expected to increase moderately with the addition of new stations.

Task 4 – Supplement calculations with reanalysis models:

a) As in previous editions of the Handbook, the direct processing of the datasets of Task 1a will be unsuccessful for stations with fewer than 8 years of data, and will also leave out of the Handbook a number of regions in the world which, for various reasons, have a scarcity of climate data. Fortunately, Research

Project 1900-RP (Roth, 2025a) has shown the feasibility of using reanalysis models such as ERA5-Land (Muñoz-Sabater et al., 2021) to "fill the gaps". The method was successfully used to calculate climatic design conditions for an additional 1,158 stations in the 2025 Handbook (Roth, 2025b). The contractor is expected to use the same technique in three types of configurations: 1. For stations that have some data within the 2003-2027 period, but not enough to successfully calculate the climatic conditions, use measured data to "calibrate" the reanalysis model, then use a longer time series produced by the "calibrated" model within 2003-2027 to calculate climatic design conditions

.

2. Use a similar technique for stations that have no data within the 2003-2027 period but have data prior to that. In previous editions of the Handbook, for some stations, data going all the way back to 1980 was used directly in the calculation of climatic conditions. This is not ideal because the climate may have changed significantly since then, and because design conditions for different stations are therefore calculated with different periods. It is suggested instead that the contractor uses a reanalysis model calibrated with older data, and calculates climatic conditions with a time series produced by the "calibrated" model within the 2003-2027 period.

3. In some areas of the world, there is just no data to either calculate the climatic design conditions or calibrate the model. In these areas, uncalibrated data from a reanalysis model observed to faithfully represent the local region can be used, as was done in Roth (2025b). This last-resort method should only be used to provide coverage in major urban centers which would otherwise be omitted in the Handbook.

Task 5 – Add other climatic design conditions:

Quantities such as clear-sky and all-sky irradiance, and precipitation, are not derived from NCEI or EC data, but are also obtained from other sources.

a) Clear-sky solar radiation In previous editions of the Handbook, the REST2 model (Gueymard, 2008) was used to calculate the coefficients taub and taud of the ASHRAE clear-sky irradiance model, using a fitting procedure at each location. The inputs of REST2 were obtained from various reanalysis or remote sensing models such as MERRA-2 (Gelaro et al. 2017), OMI (Lamsal et al., 2021), and ERA5-Land (Muñoz-Sabater et al., 2021); see Roth (2025b). It is suggested that a similar procedure be used for the 2029 edition of the Handbook.

b) All-sky solar radiation All-sky solar radiation is provided in the climatic information tables mostly for information, as it is not used directly by any design method. The 2025 edition of the Handbook used surface radiation from the CERES/EBAF model (Kato et al., 2018; see also Roth, 2025b). The contractor is invited to use a similar procedure, or propose an alternate source of data with comparable accuracy.

c) Precipitation Statistics of monthly values of precipitation (average, minimum, maximum, and standard deviation) in the 2025 edition were obtained from various observational or gridded data sets: NCEI Global Historical Climatology Network monthly (GHCNm; Applequist et al., 2024), Global Precipitation Climatology Centre (GPCC; Schneider et al., 2017), and Global Precipitation Climate Project (GPCP; Adler et al. 2018). Similar data sets are expected to be used for the 2029 edition, although the contractor is encouraged to suggest alternate datasets of comparable or enhanced coverage and accuracy.

Task 6 – Calculate temperature trends:

a) Since the 2021 edition, the Tables in the ASHRAE Handbook list historical trends for a limited set of climatic design conditions: average temperature, heating and cooling degree-days, 99% heating dry-bulb and dew-point temperatures, and 1% cooling dry-bulb, wet-bulb and dew-point temperatures. These trends are provided on a per-station and regional basis. The calculation of these trends is not always possible, and when it is, does not always lead to statistically significant values. Nevertheless, it provides a reflection of the evolution of climatic design conditions in the recent past.

b) The contractor will use a method similar to that used in the 2025 and 2021 Handbooks (Roth, 2025b), or use other sources such as the IPCC (IPCC, 2020).

c) The contractor can also consider using reanalysis models to update the trends based on the period targeted for the Handbook, calculating them with the same period for all stations, rather than using disparate periods based on the availability of hourly data used to calculate the climatic design conditions themselves.

Task 7 – Assemble the tables:

a) Using the data calculated in Task 3, supplemented by the data obtained in Task 4 for some stations, and combined with the data compiled in Tasks 5 and 6, assemble the Tables of Climatic Design Conditions for the 2029 Handbook – Fundamentals.

b) Provide an interim report to the PMS regarding the availability of the data, the number of stations successfully processed in Task 3, stations added in Task 4, and any issue uncovered in Tasks 5 and 6, and obtain the PMS's approval for the final list of stations. 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.

c) The tables will be delivered in pdf format in both SI and I-P units, for inclusion with the online and pdf versions of the handbook. Tables in flat-file format will also be provided.

Task 8 – Update Standard 169:

For the last few edition cycles, the ASHRAE Handbook and Standard 169 have been kept in sync, that is, the updated tables in the Handbook result in updated climatic conditions in Standard 169. This is achieved through three sub-tasks:

a) Calculate climate zones for all stations in the Handbook, based on their heating and cooling degree-days for the thermal zone (0 – 8), and on monthly temperature averages and precipitations totals for the moisture zone (A, B or C).

b) For the USA, assign county climate zones. Because of the uneven distribution of stations among large number of US counties, and to avoid manual and subjective processes used in the past, this is best achieved through the use of gridded datasets, as explained in Roth (2025b). It is suggested that the contractor follow a similar procedure, although they are free to propose and implement alternate methods, after consultation with the PMS.

c) Prepare maps of climate zones for the USA (based on sub-task b above), Canada and the rest of the world, and update tables A-3, A-4, A-5 and A-6 in Standard 169, and other files (e.g. station list) as needed by the standard.

d) Review and/or contribute text for inclusion in Standard 169 consistent with the new tables, figures, etc.

Task 9 – Update web-based tools:

The contractor will update two tools available from the ASHRAE Weather Data Center (https://www.ashrae.org/technical-resources/bookstore/weather-data-center):

a) The Application Programming Interface (API) server which responds to requests for climatic data in the form of the tabulated design elements and the raw frequency distribution tables underlying the calculation of climatic design conditions.

b) The Weather Data Viewer (WDView), which provides users a web interface to view and interact with the data retrieved through the API, and implements various calculation methods found in Chapter 14 of the Handbook.

c) The contractor will coordinate with ASHRAE, who are in charge of hosting the API and WDView, and implement authentication mechanisms to securely access the products.

Task 10 – Final Report, Chapter 14, and Technical Paper

The contractor will prepare a complete final report documenting project results, and review and/or supply text in Chapter 14 of the Handbook consistent with the new tables, figures, and methods. A technical paper suitable for publication in ASHRAE Transactions will also be prepared.

Deliverables:
Progress, Financial and Final Reports, Research Paper(s), and Data shall constitute the only 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/Multidisciplinary Task Group (TC/TG/MTG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Interim reports
The following interim deliverables shall be provided to the Project Monitoring Subcommittee (PMS) as described in the Scope/Technical Approach section above, as they are available:

Task 1: Provide a short interim report to the PMS summarizing the data that will be used for this project.
Task 2: Provide the PMS with a report detailing changes to the software, the method(s) used to improve outlier detection, and the method(s) used to smooth histograms.
Task 3: Provide an interim report to the PMS reviewing the number of stations having adequate data for processing, and any issues found thus far.
Task 4: Provide an interim report to the PMS detailing the number and location of stations for which a calibrated reanalysis model will be used. Also report on the number of locations for which an uncalibrated reanalysis model will be used, and how these locations were selected.
Task 5: Provide the PMS with a short report summarizing the derivation of clear-sky irradiance, all-sky radiation, and precipitation design conditions.
Task 6: Provide to the PMS a short report with results of the trend calculations, including any deviation (if any) in methodology from previous editions.
Task 7: Provide the PMS with sample tables in draft format (samples include individual PDF files, tables in flat file format, and others as appropriate). 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) for Chapter 14 of the Handbook – Fundamentals and Standard 169. Once the processing is complete, provide the PMS with a royalty-free copy of the software used to calculate the climatic design conditions.
Task 8: Provide tables and climate zone maps for Standard 169, in a format approved by the PMS.
Task 9: Provide the PMS with a beta version of the REST API and the WDView application. Then, after approval by the PMS, provide the PMS and ASHRAE with all code, databases, etc. necessary for deployment of these applications on ASHRAE servers.

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. Unless otherwise specified, electronic copies of the final report shall be furnished for review by the Society's Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG/MTG, 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. Research Paper(s)

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 for publication in the Science and Technology for the Built Environment (STBE). The paper(s) shall conform to the instructions posted in "Manuscript Central" for Science and Technology for the Built Environment papers. The paper title shall contain the research project number at the end of the title in parentheses, e.g., (1999-RP). ASHRAE Conference papers are **not** acceptable as deliverables from ASHRAE research projects unless explicitly approved by a vote of the PMS and TC and communicated to MORTS. Conference paper(s) shall conform to the instructions posted in "Manuscript Central" for ASHRAE Conference papers and the title shall contain the research project number at the end of the title in parentheses, e.g., (1999-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 $200,000 and anticipated project duration is 24 calendar months, spanning 4 ASHRAE meetings. Effort is expected to be around 12 full-time equivalent person-months, equally divided between the Principal Investigator and an assistant. Although this is not a requirement of this work statement, ASHRAE also recommends involving students in research projects, whenever the nature of the work lends itself to it.

Other Information for Bidders

The tasks presented in this Work Statement require expertise in meteorology (since the main object of the statement is to process climate data), statistics (to flag outliers and implement quality-control methods), and programming (as the tasks listed involve a large amount of data processing which is best achieved with special-purpose code).

For reference, in terms of hardware and software, the processing of climatic information data for the 2025 edition of the Handbook was achieved on fairly standard workstations but with significant storage capabilities (Merra2 requires 10 TB, ERA5Land 20 TB, and the rest another TB). Parts of the processing software are written in C++ and parts in Python; libraries and frameworks such as netCDF (C++), Pandas, Numpy, Cartopy, Flask (Python), Apache

ECharts, Leaflet (Javascript) were used. This is of course just indicative, as the contractor will be free to use whatever tools they prefer. The previous contractor is committed to working with the successful bidder to give them an introduction to the code, if they wish to do so.

Potential bidders are also encouraged to familiarize themselves with the work done for previous editions of the Handbook, at least by reading through the 1923-RP Final Report (Roth, 2025b) and, potentially, final reports for research projects linked to previous editions of the Handbook, the list of which can also be found in Roth (2025b).

Proposal Evaluation Criteria

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

	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%

Project Milestones:

Project Milestones	Major Project Completion Milestone	Deadline Month
1	Obtain data from NCEI and ECCC	4
2	Update software	10
3	Calculate climatic design conditions	14
4	Supplement calculations with reanalysis model	16
5	Add other climatic design conditions	18
6	Calculate temperature trends	20
7	Assemble the tables	22
8	Update Standard 169	24
9	Update web-based tools	24
10	Final Report, Chapter 14 and Technical Paper	24

References

1. Adler, Robert, Mathew Sapiano, George Huffman, Jian-Jian Wang, Guojun Gu, David Bolvin, Long Chiu, et al. 2018. The Global Precipitation Climatology Project (GPCP) Monthly Analysis (New Version 2.3) and a Review of 2017 Global Precipitation. Atmosphere 9 (4): 138. https://doi.org/10.3390/atmos9040138.
2. Applequist, Scott, Imke Durre, and Russell Vose. 2024. The Global Historical Climatology Network Monthly Precipitation Dataset, Version 4. Scientific Data 11 (1): 633. https://doi.org/10.1038/s41597-024-03457-z.
3. ASHRAE 2025. ASHRAE Handbook – Fundamentals. ASHRAE, Atlanta, GA.
4. Duan Zhuocheng, Pieter de Wilde, Shady Attia, and Jian Zuo. 2025. Challenges in predicting the impact of climate change on thermal building performance through simulation: A systematic review. Applied Energy 382, 125331. https://doi.org/10.1016/j.apenergy.2025.125331.

5. Dunn, Robert J. H., Kate M. Willett, David E. Parker, and Lorna Mitchell. 2016. Expanding HadISD: Quality-Controlled, Sub-Daily Station Data from 1931. Geoscientific Instrumentation, Methods and Data Systems 5 (2): 473–91. https://doi.org/10.5194/gi-5-473-2016.
6. Gelaro, Ronald, Will McCarty, Max J. Suárez, Ricardo Todling, Andrea Molod, Lawrence Takacs, Cynthia A. Randles, et al. 2017. The Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2). Journal of Climate 30 (14): 5419–54. https://doi.org/10.1175/JCLI-D-16-0758.1.
7. Gueymard Christian A 2008. REST2: High-performance solar radiation model for cloudless-sky irradiance, illuminance, and photosynthetically active radiation – Validation with a benchmark dataset. Solar Energy 82 (3) 272-285.
8. IPCC (2020). Climate Change reports, available from https://www.ipcc.ch/reports/
9. Kato, Seiji, Fred G. Rose, David A. Rutan, Tyler J. Thorsen, Norman G. Loeb, David R. Doelling, Xianglei Huang, William L. Smith, Wenying Su, and Seung-Hee Ham. 2018. Surface Irradiances of Edition 4.0 Clouds and the Earth's Radiant Energy System (CERES) Energy Balanced and Filled (EBAF) Data Product. Journal of Climate 31 (11): 4501–27. https://doi.org/10.1175/JCLI-D-17-0523.1.
10. Lamsal, Lok N., Nickolay A. Krotkov, Alexander Vasilkov, Sergey Marchenko, Wenhan Qin, Eun-Su Yang, Zachary Fasnacht, et al. 2021. Ozone Monitoring Instrument (OMI) Aura Nitrogen Dioxide Standard Product Version 4.0 with Improved Surface and Cloud Treatments. Atmospheric Measurement Techniques 14 (1): 455–79. https://doi.org/10.5194/amt-14-455-2021.
11. Muñoz-Sabater, Joaquín, Emanuel Dutra, Anna Agustí-Panareda, Clément Albergel, Gabriele Arduini, Gianpaolo Balsamo, Souhail Boussetta, et al. 2021. ERA5-Land: A State-of-the-Art Global Reanalysis Dataset for Land Applications. Earth System Science Data 13 (9): 4349–83. https://doi.org/10.5194/essd-13-4349-2021.
12. NCEI 2025.Global Historical Climatology Network hourly (GHCNh). https://www.ncei.noaa.gov/products/global-historical-climatology-network-hourly
13. Roth, Michael 2025a. Using Simulated Weather Data with Sparse Measured Data to Produce Hourly Weather Files and Calculate Design Conditions. Final Report 1900-RP. ASHRAE, Atlanta, GA.
14. Roth, Michael 2025b. Updating Climatic Design Information for the 2025 ASHRAE Handbook, Standard 169, and the Handbook of Smoke Control Engineering. ASHRAE 1923-RP Final Report. ASHRAE, Atlanta, GA.
15. Schneider, Udo, Peter Finger, Anja Meyer-Christoffer, Elke Rustemeier, Markus Ziese, and Andreas Becker. 2017. Evaluating the Hydrological Cycle over Land Using the Newly-Corrected Precipitation Climatology from the Global Precipitation Climatology Centre (GPCC). Atmosphere 8 (12): 52. https://doi.org/10.3390/atmos8030052.
16. Whittaker, E. T. 1922. On a New Method of Graduation. Proceedings of the Edinburgh Mathematical Society 41 (February): 63–75. https://doi.org/10.1017/S0013091500077853.