

CHAPTER 4

WCT INDEX: TRANSITION FROM ADVANCED DEVELOPMENT TO OPERATIONS

4.1 Introduction. The transition of the new WCTI into operations was handled within the JAG/TI through approved actions and coordinated activities. Notification of the new WCTI was sent by the Federal Coordinator to federal agencies in mid-September 2001. The purpose of this memorandum was to officially notify the federal agencies of the new recommended WCTI, to provide the Index's algorithms and charts, and to provide a summary of the JAG/TI project through an attached executive summary. Other documentation of these activities and decisions were provided to federal agencies by their C/ESORN and JAG/TI representatives and through distribution of the JAG/TI meetings' Record of Actions. Education of the meteorological community and general public was also critical to the success of the WCTI. The JAG/TI activities are summarized in Table 4.1.

4.2 Agencies' Implementation. Each weather service implemented the new WCTI and frostbite equation according to their agency procedures, which are summarized in this section.

4.1.2 National Weather Service (NWS) Implementation. The NWS implemented the new WCTI on November 1, 2001 (Nelson et al. 2002b; Tew et al. 2002). The implementation process involved three key steps which were AWIPS integration, operations integration and public education.

4.1.2.1 AWIPS Integration. In order to begin the WCTI implementation process, the new WCTI algorithm was first inserted into AWIPS. The AWIPS programs and products that use the new wind chill equation are: the Hourly Weather Roundup (HWR), the Interactive Forecast Preparation System (IFPS) products, and the Display 2-Dimensional (D2D) application.

- The HWR is composed of two software applications which summarize hourly observations from both land and marine stations. These observation summaries are disseminated over the NOAA Weather Radio as well as the NOAA Weather Wire Service (NWWS). The NWWS product is in a tabular format, with each row representing a station, and each column represents a weather element, such as temperature and wind. The WCTI value will be found in the "Remarks" column whenever the temperature, wind, and wind chill index exceed user-defined thresholds.
- The IFPS products affected by the change in the wind chill index include the Zone Forecast Product and the Revised Digital Forecast.
- Hourly WCTs can be displayed on a map background of choice on D2D within AWIPS. These observations may also be animated.

The WCTI equation with frostbite thresholds was released to all NWS WFOs in October 2001. The software changes were transmitted to each WFO through an AWIPS maintenance release by the Office of Operational Services, and the installation was monitored by the Network Control

Facility. The installation was completed before the implementation date of November 1 at all sites. The installation of the WCTI was included in the AWIPS software release 5.1.1.1.

4.1.2.2 Operations Integration. The NWS issues Wind Chill Outlooks, Wind Chill Watches, Wind Chill Warnings and Wind Chill Advisories to provide the public advance notice of dangerous or life threatening wind chill conditions. To implement the new WCTI and frostbite times, the NWS changed warning and advisory threshold values to better reflect the new index and updated national and regional policy documents to reflect the changes.

4.1.2.3 Public Education. The NWS developed an extensive education effort to inform their customers and partners about the new WCTI. The list of the educational activities included:

- issuing a public information statement on September 1, 2001 to inform the public of the upcoming change to the NWS wind chill program;
- developing and publishing the WCTI chart with frostbite times shaded on NWS web pages and the updated winter storm brochure;
- organizing mailings and seminars targeting local media, emergency managers, city and school officials;
- participating in interviews, resulting in numerous wind chill articles published in newspapers, magazines, and brochures;
- fielding several television and radio interviews; and
- establishing the NWS Wind Chill web page, which includes the NOAA WCTI chart and calculator, at: <http://www.nws.noaa.gov/om/windchill>.

4.2.2 Meteorological Service of Canada (MSC). The MSC began using the new WCTI in their forecasts on October 2, 2001, but did not have the formal implementation ceremony until October 30, 2001 (Shaykewich et al. 2002). The formal implementation ceremony, which was attended by most major media networks in Canada, took place at the DRDC site of the human trials. The equation was incorporated into the winter guidance and into the Scribe auto-generated forecast bulletin preparation program before the start of the use of the new index. MSC wrote a short Standard Operating Procedure document for use by the forecasters that was available upon start-up. It included national guidance on format and terminology as well as on climate region specific thresholds for reporting on wind chill for inclusion in a forecast and for the issuance of warnings. All of this required finalization of the WCTI by mid-August, when the initial notice was issued. Although MSC does not have a required notification time to adhere to, they do have an understanding with the media to notify them six weeks ahead of any changes. In fact, MSC worked with several media outlets during the human trials and afterward to help publicize the change and educate their public. As part of the media coverage and from the filming of the trials, Discovery Channel and The Weather Network in Canada broadcast 30 minutes of interviews, equipment, trials, and trial results.

During August 2001, MSC worked on training, more detailed talking points, information for outreach, possible questions and answers, climatology, and the relation of the old index to the new index. MSC also produced educational products for children, updated brochures, and wallet cards to reflect the new WCTI. These were distributed widely and made available via their web site. MSC developed an extensive web site which provides information on the wind chill index, including the scientific basis, April 2000 Workshop documents, the update process, an on-line downloadable wind chill calculator, equations for the WCTI and frostbite times, educational documents, charts and tables, fact sheet, and links to other JAG/TI agencies. Their web site address is: <http://www.windchill.ec.gc.ca/>.

4.2.3 Department of Defense (DOD).

4.2.3.1 United States Air Force (USAF) and United States Army (USA) Implementation. The USAF and USA began implementation of the WCTI and Minutes to Frostbite equation at worldwide locations on November 1, 2001. The USAF Director of Weather, Policy Division issued an announcement to Air Force and Army units on October 17, 2001. The USA Office of Surgeon General sent guidance to Army units on December 17, 2001. Subsequently, the information on the new WCTI and frostbite was publicized, distributed, adapted for use, included in models and weather systems, and references and publications were updated. Articles were released by the Air Force Weather Agency Office of Public Affairs to the *Air Force News* on October 26, 2001 and appeared on Air Force Radio News on October 29, 2001. The new index was introduced by several other media through safety articles, disaster preparedness briefs, and internal newsletters. The new index was also available for downloading at several military web sites.

For worldwide adaption of WCTI and Minutes to Frostbite information, an additional eight charts were created to convert to metric units, correct for the different wind measuring heights (5, 15, and 33 ft or 1.5, 4.6, and 10 m), and extend the equations from wind 45 mph (72.4 km h⁻¹ or 20 m s⁻¹) to 60 mph (96.6 km h⁻¹ or 26.8 m s⁻¹). To accomplish this extension, the USAF requested, and DRDC agreed, to rerun the WCT and Frostbite models to obtain new data values. The new charts were completed in January 2002 and distributed shortly thereafter to both the military and JAG/TI members.

Automating the new WCTI and Minutes to Frostbite equations into Air Force Weather systems will be accomplished as new versions of software are created. The WCTI was included in the March 2002 software upgrade for Air Force Weather's forecast display work station, the New Tactical Forecast System. Weather models will also be updated with the WCTI as visualization output is programmed.

As identified or reviewed, military publications will be updated with the new WCTI and Minutes to Frostbite information. For example, the Air Force Surgeon General plans to include the information in the Air Force Pamphlet 48-151, *Thermal Injury*. The USA Research Institute for Environmental Medicine (USARIEM) has already incorporated the new information into their update of the Technical Note: *Sustaining Health and Performance in Cold Weather Operations*, published in October 2001.

4.2.3.2 United States Navy (USN) and United States Marine Corps (USMC) Implementations. The USN Commander, Naval Meteorology and Oceanography Command (CNMOC) forwarded the WCTI to its subordinate commands in November 2001. Since that time, copies of the WCTI have been posted on the CNMOC Operational Support Web (both

classified and unclassified sites). In addition, the WCTI will be incorporated in the next version of the Automated Surface Observing System (ASOS) software release; the Navy has installed ASOS at its airfields.

The USMC also incorporated the WCTI in support of USMC operations worldwide during November 2001. The USMC meteorology and oceanography personnel introduced the new index to all the warfighting commands of the Marine Air Ground Task Force. The new index was also made available for downloading at several USMC military web sites.

The WCTI will be included as a new requirement into automated observing and recording weather systems as new versions of the software are fielded. The new WCTI will be updated in publications when identified or reviewed.

4.3 Summary of JAG/TI Implementation Actions. The first phase of the project covered a science review, group decisions and implementation process to update the existing U.S. and Canadian wind chill indices by the JAG/TI. The group initiated the research activity, solicited funding support, and established a time line for delivery of the new WCTI. As the project progressed, the group approved adjustments to this time line, monitored the research activity, conducted ongoing coordination with the researchers and funding agencies, and reviewed project reports by the researchers. The final form of the WCTI algorithm was obtained by the NWS and MSC at the beginning of August 2001 and implemented into their forecast centers and forecast offices' computer software. This was accomplished on September 1, 2001. DOD also obtained the WCTI by August and completed their internal coordination with the various military branches' medical and operational hierarchy.

The JAG/TI assisted agencies with the development of educational packages by arranging for the DRDC human studies to be filmed by CRREL. This also helped document the JAG/TI index verification process. Copies of the film were provided to the weather services and OFCM. In addition, a poster on the WCTI implementation (Mulherin and Phetteplace 2001) was distributed to the JAG/TI participants for use in publicizing the WCTI change. MSC also provided their educational package on CDROM and video tapes to NWS and OFCM along with additional pictures of the human studies tests. The JAG/TI members were interviewed for television reports and articles on the new index that appeared in various newspapers across the nation and in professional journals such as "Weatherwise."

The OFCM provided several documents on the WCTI project to assist in the public and federal agencies education process, including an executive summary, papers for professional meetings, media talking points, and point papers. OFCM posted the executive summary on their web site under Special Projects at: <http://www.ofcm.gov/>.

In addition, contacts were made with the Centers for Disease Control and Prevention (CDC) on updating their web site to refer to or reflect the new WCTI. CDC then set up on their web site a link to the NWS wind chill link. Office of Safety and Health Administration was also contacted to ask them to participate in future JAG/TI meetings and activities, and to update their manuals, handbooks, and relevant web sites to reflect the new WCTI.

Table 4.1 JAG/TI ACTIVITIES 2000-2002

October 2000

- Held first JAG/TI Workshop:
 - < reviewed the wind chill science and indices,
 - < reviewed existing NWS and MSC wind chill indices,
 - < agreed to have Dr. Bluestein and Mr. Osczevski develop a replacement WCTI,
 - < agreed to participate in the on-going discussions of ISB Commission 6 on UTCI, and
 - < made decision to provide position papers on wind chill and heat indices to ISB Commission 6 on JAG/TI.

February 2001

- Held second JAG/TI Workshop:
 - < reviewed the progress of the research,
 - < approved continuation of WCTI development project,
 - < revised project delivery schedule as needed, and
 - < reported on sources for project funding.
- Sent JAG/TI position paper on wind chill to ISB Commission 6.

April 2001

- DRDC and IUPUI provided tentative iterative algorithms for the new WCTI to NWS and MSC for development of and integration into weather forecaster's tools software.
- Sent JAG/TI position paper on heat indices to ISB Commission 6.
- JAG/TI members made decision to delay solar radiation inclusion in the WCTI until at least 2002.

May/June 2001

- Conducted human trials at DRDC with 12 volunteers to verify wind chill index values.
- Three JAG/TI members represented the JAG/TI and participated in the ISB Commission 6 meeting in Germany.
- CRREL filmed human trials for use with other public education material and for verification purposes.

July 2001

- The WCTI algorithm was delivered by July 10.
- Experts completed the evaluation of the new index by July 27, 2001.
- First draft of report on JAG/TI activities complete, to be reviewed at the August meeting of the JAG/TI.

July/August 2001

- NWS and MSC began integration into their workstation computers and development of the public education package.
- The trials recommended some minor changes to the WCTI, adjustments to the WCTI were accomplished by August 3 and provided to weather services.
- As part of the educational process, abstracts on JAG/TI activities and the new WCTI were submitted for presentation at National Weather Association (NWA) and at the annual American Meteorological Society (AMS) meeting.

August 2001

- Third JAG/TI Workshop held August 3 and 4 at DRDC, Toronto, Ontario, Canada:
 - < viewed DRDC wind tunnel and climate chamber where human studies were conducted,
 - < reviewed project status and implementation plans of the weather services,
 - < decided to recommend new WCTI for operational implementation,
 - < MSC, DOD, and NWS requested "time to frostbite" chart and algorithm from researchers, and
 - < reviewed draft document of JAG/TI activities.
- NWS and MSC started internal weather services education process, public/private coordination, and development of media products.

September/October 2001

- The researchers drafted a report on the results of the human studies and development of the WCTI and provided it for inclusion in JAG/TI report document.
- JAG/TI agencies reviewed and commented on draft researchers' report.
- NWS and MSC completed development of education package.
- NWS and MSC finished workstation computer software development.
- NWS issued Public Announcement Statement on new WCTI.

- NWS and MSC began education of forecast offices and public on how to use new WCTI.
- Federal Coordinator, OFCM, notified federal agencies about the new recommended WCTI.
- OFCM gave a presentation on the new WCTI at NWA annual meeting.
- DRDC developed “time to frostbite” algorithm and table, and delivered it in early October to JAG/TI members for approval and implementation.

September through November 2001

- DOD coordinated internal approval to implement new WCTI and education package.

October 31 2001

- Official Implementation of new WCT by Canada MSC.

November 1 2001

- Official Implementation of new WCT by United States NWS.

November-December 2001

- Researchers began development of solar radiation calculations/algorithms for possible addition to the WCTI.
- OFCM contacted CDC to update their web site to reflect the new WCTI.

January 2002

- OFCM, NWS, and MSC presented papers/posters on new WCTI at the AMS annual meeting.
- Fourth JAG/TI Workshop (January 18 and 19):
 - < researchers reported the status of the solar radiation calculation development project which included expressing concerns about using it in WCTI because of the complex nature of solar radiation,
 - < as a result of implementation deadlines and the scientific complexity, the solar radiation parameter incorporation, which JAG/TI approved for inclusion in the new WCTI, was postponed to be accomplished during the next couple of years,
 - < discussed how to evaluate WCTI operation,
 - < JAG/TI members began a more detailed review of the extreme heat and solar radiation problems, and
 - < JAG/TI members recommended the University of Delaware do an expanded Heat Stress Factor test in 10 cities and recommended MSC and NWS participate and provide an evaluation of the Factor to the JAG/TI.
- OFCM contacted OSHA to ask them to update their references to wind chill and to ask them to participate in JAG/TI activities.

November 2002

- JAG/TI and ISB C6 members presented papers/posters on new WCTI at the co-convened 15th AMS Conference on Biometeorology and Aerobiology/16th International Conference of Biometeorology in Kansas City, MO.
- Fifth JAG/TI Workshop (November 1 and 2), joint with the ISB C6:
 - < reviewed further development of improvement to the WCTI; changes will be implemented prior to the 2003-2004 winter season, and
 - < reviewed and discussed heat index changes; recommended postponing changes until comparative model results are available from ISB C6.