ALERT
TRANSMITTER CHARACTERISTICS

The Alert transmitter provides the capability of recognizing and encoding data from rainfall and water level sensors and then, transmitting the resulting information in real time on appropriate radio frequencies. The transmitter must be self powered and shaped to fit into the base of an ALERT rain gauge. The transmitter package must operate at unpowered remote data sites with a high level of reliability and the lowest possible maintenance requirements. In order to encourage the broadest possible involvement of many diverse organizations, the basic Alert transmitter package must be as simple, reliable and as low priced as possible while having the potential for cost effective modifications which support the operation of a broad range of ancillary hydrometeorological sensors. In order to accomplish these objectives, the following characteristics are considered to be necessary.

BASIC CONFIGURATION

1. The transmitter, supporting electronics and battery supply shall be mounted in a single weather proof enclosure with a removable water resistant lid.

2. The transmitter enclosure shall not exceed 10.5 inches in diagonal width or diameter and 23 inches in height. The total weight, excluding battery, shall not exceed 15 lbs.

3. The transmitter enclosure shall be made of noncorrosive material and provide protection against dust, dirt, splashing water and internal condensation.

4. The transmitter enclosure shall have a handle on top of the sealed lid which shall be suitable for carrying the transmitter package while a lifting rope is attached.

5. All connectors to the transmitter package shall be mounted on the lid. Only screw on water resistant connectors shall be used except, the antenna connector shall be a female BNC type.

6. The lid shall provide a connector to accommodate an alternate power source such as a solar cell for charging the battery.

7. The lid shall be held in place on top of the electronics package with secure self sealing threaded fasteners.

8. In order to minimize temperature fluctuations at remote sites, while providing a high degree of protection against vandalism, the transmitter package shall be designed for installation in the base of the rain gauge.

9. The basic electronics package will have connectors for two digital sensors. The first for incremental precipitation sensing and the second for bidirectional incremental water level sensing.

10. The transmitter shall have a convenient means of setting a

station ID. which corresponds to the range of values appropriate to the transmission code in use.The number selected will represent the input port used for the incremental precipitation sensor. Other incremental (digital) sensors will utilize ID's which decrease from the precipitation sensor's ID. Analog sensors will be identified in sequence by adding 1 to the previous sensor ID. If a precipitation gauge is not attached to the transmitter, the station ID will represent water level.

11. The transmitter shall provide a means of varying the warmup time prior to transmitting the data signal. Signal modulation should be capable of successful decoding at a nearby base station with a lead time of 100 milliseconds and through a relay system with proportionally longer lead times. However, the warmup time shall not exceed 600 milliseconds.

12. The transmitter shall transmit check signals at approximately 12 hour intervals utilizing a single sensor as the principle station ID. This ID will be rainfall if the station is equipped with a rain gauge.

13. The battery supply shall be adequate to operate the transmitter for one year with no interim recharging. ie: after one year of use with less than one thousand transmissions, the battery should be capable of 25,000 additional transmissions.

14. The transmitter shall have an automatic cutoff device which prevents the transmitter from sending emissions longer than seven seconds. This feature is intended to prevent a transmitter from continuous emissions which could jam the frequency in use.

15. Transmissions from a single sensor will be constrained such that a period of 10 to 15 seconds must elapse between consecutive transmissions. Test signals shall be capable of being transmitted without changing the accumulator values.

16. The transmitter shall not transmit any sensor ID other than those to which a sensor is attached.

17. All new transmitters installed in the Alert System after the approval of these specifications shall utilize either the binary or the enhanced data format as previously approved by the Alert Users Group.

18. The transmitter shall use an FSK transmission form and be F.C.C. type accepted, (type certified to part 90 and part 2). VHF transmitters shall utilize an output power not to exceed 10 watts. Higher output levels should be available by special order but shall be utilized only with appropriate authorization and licensing.

19. Transmissions will be frequency controlled consistent with F.C.C. regulations through an operating range of -20 degrees C to +60 degrees C.

20. Transmitted messages will conform to the CCITT standard specifying Logic 1 at 2133Hz and Logic 0 at 1920Hz.

21. The transmitter should be available for those frequencies licensed for the transmission of hydrometeorological data.

22. To restrict extraneous transmissions of water levels, the following features should be selectable for digital bidirectional water level sensors used in an event mode.
    a) A lockout time during which consecutive transmissions will be prevented.(Example: a rotary switch with positions 0 through 9 might use 9 to create a 3600 second, one hour, lockout with each lower number cutting the lockout time in half. Lockouts would then represent the following potential - times in seconds. 3600,1800,900,450,225,112,56,28,14,7)
    b) The capability of varying the number of increments beyond a single increment which must occur to constitute an event and generate a transmission. (Example: 0 through 9 additional increments)
    c) An over ride which initiates a transmission during the lockout time if an indicated number of events should occur. (Example: if 5 is selected on an over ride switch, which had a range of 0 through 9 events, then five events occurring in the lockout time would over ride the timed lock out and the fifth event would be transmitted.)

ENHANCED CAPABILITIES

In addition to the basic capabilities reviewed above, the transmitter should be capable of being enhanced to provide the following additional features.

1. The electronic package should allow up to four digital (incremental) and eight analog sensors to operate with a common transmitter.

2. ALL UNUSED PORTS MUST BE INCAPABLE OF BEING TRANSMITTED!

3. All analog sensors will be read and transmitted on a user determined time schedule controlled by an internal clock in the electronic package - as an example, the available choices might include such choices as Event, 3, 7, 10, 15, 20, 30 minutes, 1, 2, 3, 4, 5, 6, 12 hours.

4. The ID assignments for transmitters configured for weather station use shall follow the following schedule.
    ID-3 Wind Run and Direction
    ID-2 Optional event sensor
    ID-1 Event River Sensor
    ID One Millimeter Event Precipitation Gauge
    ID+1 Relative Humidity
    ID+2 Temperature
    ID+3 Optional Analog Sensor
    ID+4 Atmospheric Pressure
    Additional Ports shall be used for appropriate hydrometeorological sensors.

5. The transmitter features defined for water level transmissions under 22 a,b, and c would also apply to wind run. However, the timed lockout would have an override with no more than 8 units of wind run.

May 1989

ALERT RAIN GAUGE ATTRIBUTES

THE GAUGE HOUSING

1) The gauge housing shall be a straight sided cylinder to provide a uniform aerodynamic profile and to reduce the vertical lift over the orifice induced by slope-sided or shouldered gauges. (Jones, 1969).

2) The gauge shall utilize a 12 inch diameter orifice to allow better dissipation of the wind generated pressure jump at the upwind edge of the orifice which tends to carry precipitation across the throat of gauges with smaller orifices. (Robinson & Rodda, 1969).

3) Due to the remote siting of most ALERT rain gauges, they will utilize an orifice level which is approximately ten feet above ground level. This is intended to discourage vandalism, to reduce variations in rain gauge effectiveness which are associated with seasonal changes in nearby vegetation and to support a radio antenna at an elevation which will contribute to effective radio trans missions.

4) The gauge will consist of a simple, cylindrical, noncorrosive metal container designed to provide an integrated catch area, tipping bucket enclosure, below ground electronic vault, and antenna support.

5) Consistent with other design features, the gauge should have a minimum adverse environmental impact and be highly resistant to environmental stress.

6) In order to minimize the hazards of vandalism and a potential for radio frequency disruption, non secure sites should have no ground-level doors, no side openings or any apparent access to the transmitter package.

7) Tight-fitting, noncorrosive screens, one of approximately 12" in diameter, shall be set below orifice level and the second of approximately 3 1/2" in diameter shall be recessed into the gauge funnel. The screens should provide a high degree of protection from debris, leaves, pine needles, insects, and bird droppings entering the tipping bucket mechanism. The screens should not interfere with effective precipitation measurement.

8) Measured precipitation shall be discharged from the gauge to maintain vault area dryness. Discharge vents shall be screened to reduce insect entry. Vent holes should minimize wind entry while assuring adequate drainage. The vent holes should have a wind baffle located inward from the vent hole such that the performance of the tipping bucket will not be affected at wind speeds of thirty miles per hour.

9) The upper edge of the funnel leading to the tipping bucket will be 12" in diameter while the outlet of the funnel must be

1 centimeter in diameter plus or minus 1 mm.. Too large an opening at the base of the funnel can result in rainfall bypassing the bucket mechanism while too small an opening can become obstructed.

10) A vent tube between the electronic vault area and the tipping bucket chamber should allow air to escape from the lower chamber to decrease the potential for condensation. The vent tube must be of sufficient diameter to allow air flow and to accommodate the connector of the signal wire between the tipping bucket and the electronic package. The vent tube should project into the tipping bucket chamber in a manner which prevents drainage into the lower housing of any fluid which has passed through the tipping bucket mechanism.

11) The base of the gauge shall provide a watertight seal for the lower portion of the electronic vault and shall be made of noncorrosive metal which will aid in grounding the gauge structure in the event of a lightning strike. The base of the gauge, (lower two feet) will be unpainted to maximize its grounding potential.

12) Major components in the cylindrical structure will be connected directly to one another or through the use of slip rings such that the upper section overhangs the lower section in a manner that will minimize the opportunity for precipitation entering the gauge through component joints. Interchangeability of components between vendors is desireable.

13) All external fastenings joining components of the rain gauge will be stainless steel machine screws with Allen or other complex screw head types which minimize the opportunity for vandalism. Such screws should pass through slotted openings to firmly mounted stainless or non corrosive fasteners.

14) The basic antenna shall be a unity gain stainless steel whip. In order to eliminate drip into the orifice, no antenna elements may extend within 60 mm. of a vertical projection of the orifice. The antenna mast shall not exceed 50 mm. in diameter. The standpipe shall include an antenna mast assembly that encloses all wires leading to the antenna and to sensors mounted on the antenna mast.

15) The upper section of the standpipe (within 12" of the top) shall have an internal fastening for securing the lifting rope attached to the transmitter.

16) Optional solar panels should be mounted on the lower portion of the tipping gouge housing. Solar panels should be mounted as close to the housing as possible and be within 10 degrees of a vertical position. This location is intended to minimize wind disturbances to the orifice and to allow rainfall to cleanse the face of the panel. The panel charging circuit should prevent the possibility of overcharging or discharging the battery system.

THE TIPPING BUCKET

17) The upper gauge section should enclose a tipping bucket mechanism with noncorrosive bearings which requires a full throw and alternating tips for signal transmission.

18) In order to minimize damage to the tipping bucket from temperature variations (expansion and contraction) and/or freezing of water in the bucket, the tipping bucket mechanism must withstand repeated freezing and thawing when nearly full.

19) The bucket should be activated by 1 mm. of rainfall. Such a volume provides good resolution while requiring sufficient mass to reduce wind flutter and precipitation balancing which has been reported with buckets of .25 mm. or less.

20) The tipping bucket unit should be calibrated within 1.5 percent accuracy at a rainfall rate of 150 mm. per hour.

21) The tipping bucket should utilize magnetic switching to minimize the potential for contact problems.

22) The funnel on the tipping bucket should have low thermal conductivity to reduce the potential for flash freezing when rainfall is occurring at below freezing temperatures.

23) Adjustment screws used for calibrating the tipping bucket should be molded of nylon or other resilient material which will not deform or fuse to the bucket when exposed to temperatures of 200 degrees fahrenheit.

24) The tipping bucket should include a self-contained leveling system to assist in proper leveling of the tipping bucket unit.

25) The tipping bucket shall be well secured in position below the funnel.

ASCII FORMAT

MAY 1989 S____11011E / S____11011E / S____11011E / S____11011E

AAAA AAAA DDDD DDDD

MAY 1989 ALERT DATA FORMATS

The technical review committee of the California Nevada Alert Users Group has completed the current phase of its analysis of formats which could improve the data recovery capability of Alert messages. It was determined that 300 baud messages had some uniquely important radio transmission characteristics which made it desirable to optimize 300 baud messages. The 300 baud enhanced format resulting from this review was the result of combining concepts of the many participants in the format discussions. A new 300 baud enhanced format was unanimously recommended for adoption by the technical committee on June 15, 1988 at a meeting held in Santa Clara, California.

Implementation of the enhanced format establishes the requirement for Smarter relays in the Alert system. In order to eliminate retransmission of undesirable radio traffic, Smarter relays must have the ability to recognize and to relay existing binary formatted messages as well as the enhanced format. This requires verification of an approved station ID for binary encoded data and verification of an appropriate message structure for messages utilizing the enhanced format. The message structure and required checking appropriate to each format is listed below.

BINARY FORMAT - STATION ID CHECKING

SAAAAAA10E SAAAAAA10E SADDDDD11E SDDDDDD11E

ENHANCED FORMAT - RAINFALL - CONSTRAINED CRC

SAAAAAA11E SAAAAAADDE SDDDDDDDDE SDBCCCCCCE

ENHANCED FORMAT - WIND RUN REPORTS WITH GUSTS - ID CHECKING

SAAAAAA11E SAAAAAADDE SDDDDVVVVE SVBGGGGGGE

ENHANCED FORMAT - WIND RUN REPORTS - CRC

SAAAAAA11E SAAAAAADDE SDDDDVVVVE SVBCCCCCCE

ENHANCED FORMAT - ALL OTHER DATA - CRC

SAAAAAA11E SAAAAAADDE SDDDDDDDDE SDBCCCCCCE

It is envisioned that " Smarter Relays " would identify whether a message was a binary or an enhanced format. The relay would transmit only those binary messages which matched the acceptable station identifier list established for that relay. Messages recognized as the enhanced format would also pass an ID test to establish the messages appropriateness for retransmission by that particular relay (this would eliminate undesired transfers between nearby networks on the same frequencies). If the address indicates the enhanced message is a desired address conveying a wind report with gust information, no further check is required for retransmission. All other enhanced messages should be subjected to a two phase CRC process. The CRC should first be applied to the total message, if the message checks, the message should be retransmitted. If the first phase CRC fails, the CRC should be verified as though the data accumulator bits were all zeroes, if this test is passed, the message is retransmitted. If none of the tests are passed, the message is discarded. ie:retransmission does not occur.

The CRC utilized for the enhanced Alert format should be:

x**6 + x**4 + x**3 + 1

Bit uses: S = Start E = End
A = Address - limit 4095 1 and 0 are format identifiers
C = Six bit CRC G Six bit gust data
D = Data accumulator (direction in wind reports)
V = Wind run counter