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FDA 510(k) Summary

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Section 807.92

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Coutact Person: Robert W, Thatcher. Ph.D. Applied Neuroscience, Inc.., 228 176ᵗʰ Terrace Drive, St. Petersburg, FL 33708. Phone: (727) 392-7851; Fax: (727) 319-1027; email: rwthatcher@yahoo.com.

Date of preparation: 5/9/2004

(a)(2). Name of the Device: NeuroGuide Analysis System (NAS). **Classification name:** EEG Frequency Spectrum Analyzer.

(a)(3). Predicate/legally marketed devices upon which substantial equivalence is based: Cordis Brain State Analyzer (no FDA information available); TECA Corporation Neurolab I, II (K844481), Brain Mapper (K890-881), Neuromapper 386 (K894889); Nicolet BEAM I, II (no FDA 510(k) information available); Pathfinder II (K801604); Brain Functional Map (K843598); Cadwell Laboratories, Inc. 8400 (K860801) and Spectrum 32 (K860801 reference); Lexicor Medical Technology Neurosearch-24 (K904269), Neurosearch-4 (K920038); Neuroscience, Inc. Map-10 EEG (K840430), Neuromapper 1620 (K870263); Biologics Systems Corporation. Inc., Modified Brain Atlas III (K854362), Bio-Logic Automatic Event Analysis (K951594); Quantified Signal Imaging, Inc. QSI-9500 (K904294), QSI-9200 (FDA 510(k) information not available); Stellate Systems, Inc. Rhythm Software (K912938); NxLink, Inc. *(K974748).*

(a)(4). Device Description: The NeuroGuide Analysis System (NAS) is a software program for the post-hoc statistical analysis of the human electroencephalogram (EEG). EEG recorded on a separate device (i.e., the host system) is transferred to the NAS for display and user-review. The system requires that the user select reliable samples of artifact-free, eyes-closed or eyes open, resting digital EEG for purposes of analysis. Analysis consists of the Fast-Fourier Transformation (FFT) of the data to extract the spectral power for each of the four primary frequency bands (delta, theta, alpha, and beta), and frequency information from the EEG. The results of this analysis are then subjected to univariate, bivariate, and multivariate statistical analyses and displayed in statistical tables and topographical brain maps of absolute and relative power, power asymmetry, and coherence for 19 monopolar and 171 selected bipolar derivations of the EEG. In all over 1,200 measures are derived for comparison against a carefully constructed and statistically controlled age-regressed, normative database in which the variables have been transformed and confirmed for their Gaussian distribution. Each variable extracted by the analysis is compared to the database using parametric statistical procedures that express the differences between the patient and an appropriate age-matched reference group in the form of Z-scores. Multivariate features are compared to the normative

database using Gaussian Univariate and Multivariate Distance Statistics. The Gaussian multivariate Distance statistic controls for the interrelationship of the measures of brain cortical function in the feature set, and provides an accurate estimate of their difference from normal. The multivariate measures permit an evaluation of regional indices of brain function that reflect the perfusion fields of the brain. Extracted feature sets are further analyzed to determine if the pattern of 'hits' (statistically significant feature score values identified for the patient) are consistent with patterns of 'hits' identified in prior neuroguide evaluations of clinical patients with known disorders. A step-wise discriminate analysis program classifies the patient in terms of their similarity to known neuroguide-defined patterns of abnormality, providing a probability estimate of the patient's profile with the average profile of groups of individuals constituting the normative and clinical database. The discriminant classification program is restricted by confining potential outcomes to specific patient symptoms derived from the patient history profile. Established discriminant functions were evaluated through the use of Receiver Operating Characteristic (ROC) curves for their sensitivity and specificity. The outcome of the statistical analysis is presented in report form that includes (a) patient demographic and history information, (b) selected EEG epochs, (c) statistical tables of monopolar, bipolar, and multivariate extracted feature values, and topographical brain maps. This information is to be read and interpreted within the context of the current clinical assessment of the patient by the attending physician/clinician. The decision to accept or reject the results of the neuroguide analysis, and incorporate these results into their clinical appraisal of the patient, is dependent upon the judgment of the attending physician or clinician.

The NeuroGuide Analysis System is complete on a single CD, which contains a demonstration program with sample NeuroGuide studies, the NAS program, and the print program. The NAS was designed for implementation under Windows, and programmed using C. The user interface was carefully designed and implemented to permit the program to be easy to use, highly reliable in its performance. A variety of control procedures are used to record stops used in program usage, and the conduct of the analysis to insure appropriate function end operation of the software. The NAS can be installed in any appropriately configured IBM-compatible computer system, including systems designed specifically for the recording of digital EEG. The system functions with a wide-range of standard computer platforms and input-output devices, and printers.

(a)(5). Statement of Indications of Use: Indications for the use of the NeuroGuide Analysis System (NAS) are as follows:

Indications of Use

The NeuroGuide Analysis system is to be used by qualified medical and qualified clinical professionals for the post-hoc statistical evaluation of the human electroencephalogram (EEG).

(a)(6). Comparison to Predicate Devices: The NeuroGuide Analysis System uses essentially the same accepted methods of data selection and analysis of predicate devices

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to extract the feature measures upon which statistical determination of normal/abnormal are made, and from which derivations of probability estimates of clinical classification are derived. The neuroguide method of EEG selection, analysis, and interpretation have been previously implemented, in whole or in part, in a variety of digital EEG and analysis systems marketed in prior years for the quantitative analysis of the EEG in Man. The NAS database, the same as for predicate devices, was carefully constructed to control for potential sources of Type I and Type II errors in the use of database comparisons in clinical electrophysiological assessment of the human EEG. The purposeful, easy to use, and reliable design of the NAS has been enhanced relative to these earlier systems through the careful consideration of user interactions by optimizing on the speed of modern computer technology to facilitate user feedback and hypothesis testing with mouse clicks.

(b). Non-clinical and Clinical Tests: The NeuroGuide Analysis System's design and implementation was based upon the results of an extensive, 25-year effort to construct a viable normative and clinical database at the Applied Neuroscience Laboratory (ANL) at the University of Maryland. The NAS incorporates the basic methods of data collection, data selection, analysis, and interpretation developed at the ANL during the conduct of numerous government and privately funded normative and clinical database projects

(b)(1). Non-clinical Testing: Non-clinical testing of the NAS included the evaluation of the algorithms and statistical methods used for data analysis. Specifically, control signals, in the form of signal generated waveforms, were analyzed for frequency and power- EEG signals were analyzed for conformity between the host digital EEG system and the NAS. The NAS includes a feature that reproduces sampling frequency in the host digital EEG system, and permits the visualization and evaluation of the EEG waveform for accuracy between the host system and the NAS translation. In addition, data obtained in previous implementations of the NeuroGuide analysis method were evaluated for consistency and accuracy -- the results of the NAS's analysis of stored subject data had to conform to that of the prior analysis (which was conducted using the same method and procedures, algorithms and method of analysis as that implemented on the NAS).

(b)(2). Clinical Testing: The ability of the NAS to accurately translate and present EEGs from clinical patients was confirmed by the non-clinical testing. In order for the NAS to be an effective implementation of the neuroguide method for clinical use, the results of the analysis (both statistical tables and topographical brain maps) had to be in agreement with the results of the analysis conducted on the host system used in the processing of patient information at the Applied Neuroscience Laboratory. In addition, the outcome of the discriminant analysis had to be consistent, not resulting in errors of misclassification (that is, the classification on the NAS had to be consistent with that of the host system used to perform the NeuroGuide analysis at the ANL). These tests confirmed that when eyes-closed resting, and artifact-free EEG was selected for analysis, the results were reproducible within an acceptable degree of variation consistent with reliability estimates identified in the normative studies.

Subjects upon which this device has been tested included individuals which ranged in age

from 2 months to 82 years, and who were either volunteers or clinical patients referred for neuroguide evaluation to the Applied Neuroscience Laboratory by the Department of Psychiatry University of Maryland School of Medicine, and/or Shock Trauma and the Applied Neuroscience Institute at the University of Maryland Eastern Shore. The results of the analysis were conveyed to the referring physician or Ph.D. clinician who was asked to use the information as an adjunct to their clinical interpretation of the patient's traditional EEG. The information was provided in report form (including EEG epochs selected for analysis, statistical tables and topographic brain maps, and the result of the discriminant analysis) to permit the physician or Ph.D. clinician to determine its relevance to their clinical evaluation and diagnosis or treatment of the patient. When the results are used in this manner, the likelihood of introducing error into diagnosis and treatment is substantially reduced. That is, the test is viewed as an adjunct to the evaluation of the patient, and does not serve as a primary basis for the diagnosis.

Potential adverse effects of the use of the device are known if the NeuroGuide Analysis System is used as a stand-alone diagnostic system (a use that is specifically contraindicated by Applied Neuroscience, Inc. and the system's developers) in the absence of other clinical data from more traditional means of patient evaluation. Relying only upon the use of a single index (such as relative power, or the topographical maps alone) without reviewing the traditional EEG, the epochs selected for analysis, or the complete set of statistical summary tables is also contraindicated and a source of potential error. Additional sources of error could arise from the inappropriate selection of EEG (selecting artifacted EEG epochs, or selecting EEG representative of other states, such as drowsiness or eyes-open EEG when comparing to an eyes closed database, or by purposely selecting conditions for testing other than those specified. Additionally, it is possible that errors will occur through the purposeful falsification of symptoms in the patient history, and patient age.

(b)(3) Conclusions Drawn From Non-Clinical and Clinical Testing: The appropriate use of the NeuroGuide Analysis System as an adjunct to the traditional visually-appraised EEG provides the user with the ability to quantify EEG variables and use them to answer questions drawn from their clinical experience with the patient. When used by an experienced, qualified practitioner, or under the proper supervision of a qualified medical professional, the NAS is concluded to be a useful and beneficial addition to the array of clinically accepted medical tests and devices used to evaluate brain structure and function.

The results of non-clinical and clinical resting conducted over the past 25 years demonstrates that the NAS is both safe and effective for the quantitative analysis of the eyes-closed resting EEG in the alert human subject and to be used to help determine if the EEG is normal or abnormal, and if abnormal, to statistically characterize the distribution of selected derived features by their probability of being similarly distributed in specified groups of clinical patients, the NAS provides information that both complements and supplements the outcome of the analysis of a traditional EEG. This information, when properly used in conjunction with other clinical tests as a safe and effective adjunctive aid to diagnosis, treatment planning, and treatment follow-up of the neurologic and psychiatric patient.

Compared to its predicate devices, the NeuroGuide Analysis System's inclusion of specific, appropriate, reliable and effective statistical controls over the method of data selection and analysis, the scientific rigor involved in the construction, refinement, and application of the normative and clinical databases, and the potential for providing practitioner with sensitive and specific quantitative indices of brain structure and function that is both safe and effective and suggests that the NAS is a significant advancement in the use of quantitative technology in neurology, psychiatry, and clinical neuropsychology and is an advancement over predicate EEG analysis systems in terms of speed and ease of use.

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President
Applied Neuroscience, Inc.
228 176th Terrace Drive
Redington Shores, Florida 33708

Re: K041263
    Trade/Device Name: NeuroGuide Analysis System (NAS)
    Regulation Number: 21 CFR 882.1400, 21 CFR 882.1420
    Regulation Name: Electroencephalograph; Electroencephalogram (EEG) signal spectrum
                    analyzer
    Regulatory Class: II
    Product Code: GWQ, GWS
    Dated: July 20, 2004
    Received: July 22, 2004

Dear Dr. Thatcher:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to such additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

This letter will allow you to begin marketing your device as described in your Section 510(k) premarket notification. The FDA finding of substantial equivalence of your device to a legally marketed predicate device results in a classification for your device and thus, permits your device to proceed to the market.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please contact the Office of Compliance at (301) 594-4659. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21CFR Part 807.97). You may obtain other general information on your responsibilities under the Act from the Division of Small Manufacturers, International and Consumer Assistance at its toll-free number (800) 638-2041 or (301) 443-6597 or at its Internet address http://www.fda.gov/cdrh/dsma/dsmamain.html

Sincerely yours,

Miriam C. Provost

for Celia M. Witten, Ph.D., M.D.
Director
Division of General, Restorative
 and Neurological Devices
Office of Device Evaluation
Center for Devices and Radiological Health

Enclosure

Indications for Use

510(k) Number (if known): K041263

Device Name: NeuroGuide Analysis System

Indications For Use: For clinical use the NeuroGuide Analysis system is to be used by qualified medical or clinical professionals for the statistical evaluation of the human electroencephalogram (EEG).

Prescription Use _____   AND/OR   Over-The-Counter Use ___X____
(Part 21 CFR 801 Subpart D)   (21 CFR 801 Subpart C)

  (PLEASE DO NOT WRITE BELOW THIS LINE-CONTINUE ON ANOTHER PAGE IF NEEDED)

Concurrence of CDRH, Office of Device Evaluation (ODE)

Miriam C. Provost

(Division Sign-Off)   Page 1 of _____
Division of General, Restorative,
and Neurological Devices

510(k) Number _K041263_