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## DEPARTMENT OF HEALTH AND HUMAN SERVICES

### Food and Drug Administration

#### 21 CFR Part 888

[Docket No. 95N-0176]

#### Orthopedic Devices: Classification, Reclassification, and Codification of Pedicle Screw Spinal Systems

**AGENCY:** Food and Drug Administration, HHS.

**ACTION:** Proposed rule.

**SUMMARY:** The Food and Drug Administration (FDA) is proposing to classify certain unclassified preamendments pedicle screw spinal systems into class II (special controls), and to reclassify certain postamendments pedicle screw spinal systems from class III (premarket approval) to class II. FDA is also issuing for public comment the recommendations of the Orthopedic and Rehabilitation Devices Panel (the Panel) concerning the classification of pedicle screw spinal systems, and the agency's tentative findings on the Panel's recommendations. After considering any public comments on the Panel's recommendations and FDA's proposed classification, in addition to any other relevant information that bears on this action, FDA will publish a final regulation classifying the device. This action is being taken because the agency believes that there is sufficient information to establish special controls that will provide reasonable assurance of its safety and effectiveness.

**DATES:** Written comments by January 2, 1996.

**ADDRESSES:** Submit written comments to the Dockets Management Branch (HFA-305), Food and Drug Administration, rm. 1-23, 12420 Parklawn Dr., Rockville, MD 20857.

**FOR FURTHER INFORMATION CONTACT:** Mark N. Melkerson, Center for Devices and Radiological Health (HFZ-410), Food and Drug Administration, 9200 Corporate Blvd., Rockville, MD 20850, 301-594-2036.

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#### I. Highlights of the Proposal

FDA is issuing for public comment several recommendations of the Panel concerning the classification of pedicle screw spinal systems. The Panel recommended that FDA classify into class II the unclassified preamendments pedicle screw spinal system intended for the treatment of severe spondylolisthesis (grades 3 and 4) of the fifth lumbar vertebra in patients receiving fusion by autogenous bone graft having implants attached to the lumbar and sacral spine with removal of the implant after the attainment of a solid fusion. The Panel also recommended that FDA reclassify the postamendments pedicle screw spinal system intended for degenerative spondylolisthesis and spinal trauma from class III to class II. For all other indications, pedicle screw spinal systems are considered postamendments class III devices for which premarket approval is required. The Panel made its recommendations after reviewing information presented at two public meetings on August 20, 1993 and July 23, 1994, and after reviewing information which was solicited in response to an April 3, 1995, letter. FDA is also issuing for public comment its tentative findings on the Panel's recommendations. FDA is proposing to expand the intended uses of the device identified by the Panel to include pedicle screw spinal systems intended to provide immobilization and stabilization of spinal segments as an adjunct to fusion in the treatment of acute and chronic instabilities and deformities, including spondylolisthesis, fractures and dislocations, scoliosis, kyphosis, and spinal tumors. Finally, FDA is proposing to codify the classification of both the preamendments and the postamendments device in one regulation. Comments received in response to this proposed rule, along with other relevant information that the agency may obtain, will be relied upon by the agency in formulating a final position on each of the foregoing issues and provide the basis for a final agency regulation.

#### II. Background

The Federal Food, Drug, and Cosmetic Act (the act), as amended by the Medical Device Amendments of 1976 (the 1976 amendments) and the Safe Medical Devices Act of 1990 (the SMDA) established a comprehensive system for the regulation of medical devices intended for human use. Section 513 of the act (21 U.S.C. 360c) established three categories (classes) of devices, depending on the regulatory controls needed to provide reasonable assurance of their safety and effectiveness. The three categories are as follows: Class I, general controls; class II, special controls; and class III, premarket approval. Devices that were in commercial distribution before May 28, 1976 (the date of enactment of the amendments) are classified under section 513 of the act (21 U.S.C. 360c) after FDA has: (1) Received a recommendation from a device classification panel (an FDA advisory committee); (2) published the panel's recommendation for comment, along with a proposed regulation classifying the device; and (3) published a final regulation classifying the device. A device that is first offered for commercial distribution after May 28, 1976, and is substantially equivalent to a device classified under this scheme, is also classified into the same class as the device to which it is substantially equivalent.

A device that was not in commercial distribution prior to May 28, 1976, and that is not substantially equivalent to a preamendments device, is classified by statute into class III without any FDA rulemaking proceedings. The agency determines whether new devices are substantially equivalent to previously offered devices by means of the premarket notification procedure in section 510(k) of the act (21 U.S.C. 360(k)) and part 807 of the regulations (21 CFR part 807).

The pedicle screw spinal system intended for indications other than severe spondylolisthesis is a postamendment device classified into class III under section 513 (f) of the act (21 U.S.C. 360c(f)). In accordance with sections 513(e) and (f) of the act and 21 CFR 860.134, based on new information with respect to the device, FDA, on its own initiative, is proposing to reclassify this device from class III to class II when intended to provide immobilization and stabilization of spinal segments as an adjunct to fusion in the treatment of acute and chronic instabilities and deformities, including spondylolisthesis, fractures and dislocations, scoliosis, kyphosis, and

spinal tumors. Such intended uses encompass both degenerative spondylolisthesis and spinal trauma. In addition, FDA is proposing to classify the preamendments pedicle screw spinal system intended for the treatment of severe spondylolisthesis into class II, in accordance with section 513(d) of the act and 21 CFR 860.84.

FDA is proposing to place the pedicle screw spinal system in class II because it believes that there is sufficient information to establish special controls to provide reasonable assurance of its safety and effectiveness.

Two categories of spinal fixation implants that were in commercial distribution prior to the date of enactment of the amendments have been classified into class II: Posterior hook-rod fixation devices (classification: 21 CFR 888.3050, Spinal interlaminar fixation orthosis) and anterior plate-screw-cable fixation devices (classification: 21 CFR 888.3060, Spinal intervertebral body fixation orthosis). In addition, bone plates and screws were placed into class II when intended for general orthopedic use in long bone fracture fixation (classifications: 21 CFR 888.3030, Single/multiple component metallic bone fixation appliances and accessories). However, bone plates and screws were considered postamendments class III devices when incorporated into pedicle screw spinal systems. This proposal does not affect the classification of those devices.

Pedicle screw spinal systems include a broad category of multiple component implants. The first premarket notification submission (510(k)) for a multiple component device system intended for attachment to the spine via the pedicles of the vertebrae was submitted to FDA for marketing clearance in 1984. FDA determined that the device was not substantially equivalent to the following devices: (1) Single/multiple component metallic bone fixation appliances and accessories intended for long bone fracture fixation; and (2) interlaminar spinal fixation device systems that attached to the spine via sublaminar wiring or interlaminar hooks. FDA's decision was based on the fact that the sponsor had not established that there was a preamendments device incorporating pedicle screw components and that the device posed potential risks not exhibited by other spinal fixation systems, such as a greater chance of neurological deficit due to imprecise screw placement or the event of a screw failure; pedicle fracture during placement of screws; soft tissue damage or inadequate fusion due to bending or fracture of device components; and

greater risk of pseudarthrosis due to instability of the device design. Because they were not found to be substantially equivalent to a preamendments device, these systems were automatically classified into class III under section 513(f)(1) of the act.

In 1985, in response to another 510(k), FDA determined that the interlaminar spinal fixation device (i.e., rods and hooks and/or sublaminar wires) with screws attached to the sacrum was substantially equivalent to the class II interlaminar spinal fixation device with hooks supported on a rod threaded into the iliac crests (21 CFR 888.3050). However, when the same device was fixed to the pedicles, FDA determined that the device was not substantially equivalent to the spinal interlaminar fixation orthosis (21 CFR 888.3050) and is therefore a postamendments class III device.

Clinical investigations of pedicle screw spinal systems under investigational device exemption (IDE) protocols began in 1985. No premarket approval application has been brought before the advisory panel or approved to date.

By mid-1992, FDA discovered that the use of pedicle screw spinal systems outside of approved IDE studies was widespread, and that pedicle screw fixation was considered to be the standard of care by the surgical community. To obtain guidance in resolving this issue in the best interests of the public health, FDA convened an advisory panel meeting on August 20, 1993, to review the available information pertaining to the safety and effectiveness of the device. Mechanical testing data, summaries of clinical studies conducted under FDA-approved IDE protocols, and presentations by experts in the field were presented to the Panel. After reviewing the information, the Panel concluded that pedicle screw spinal devices appear to be safe and effective when used as adjuncts to spinal fusion procedures, but that additional clinical information was needed in order to determine what regulatory controls should be required to provide reasonable assurance of their safety and effectiveness.

During a February 1993 meeting, FDA requested the orthopedic professional societies and spinal implant manufacturers to submit to FDA all available valid scientific data on the performance of pedicle screw spinal devices. In response, the Spinal Implant Manufacturers Group (SIMG) was formed to provide the financing for a nationwide study of the pedicle screw device. The SIMG consists of representatives from the American

Academy of Orthopedic Surgeons, the Scoliosis Research Society, the North American Spine Society, the American Association of Neurological Surgeons, the Congress of Neurological Surgeons, and 25 manufacturers of spinal implant systems. The Scientific Committee of the SIMG, consisting of surgeons and scientists, was formed specifically to develop and implement a uniform research protocol to gather clinical experience from the use of the device. FDA also provided extensive input into the design of the study protocol. With the permission of individual IDE sponsors, FDA's scientific staff provided the Scientific Committee with information about current IDE clinical investigations, the types of diagnostic groups being studied, the patient inclusion and exclusion criteria utilized, the outcome variables under study, and insight into the types of problems encountered with these studies. FDA also made recommendations regarding the feasibility of various study designs, including an historical cohort model. Finally, FDA provided the Scientific Committee with extensive advice regarding statistical analysis of the data, validation of data, reduction of study bias, and sample size calculations. The Scientific Committee then conducted a nationwide historical cohort study according to this research protocol.

The Panel met on August 20, 1993, and July 22, 1994, in open public meetings to discuss the postamendments pedicle screw spinal system. At the July 22, 1994, meeting, new information was presented to the Panel by FDA and others, and recommendations were solicited from the Panel regarding the classification of pedicle screw spinal systems. During this meeting, the Panel heard testimony from FDA, the medical and scientific communities, manufacturers, and the public regarding the safety and effectiveness of the device. At this meeting, the SIMG presented clinical data from its nationwide "Historical Cohort Study of Pedicle Screw Fixation in Thoracic, Lumbar, and Sacral Spinal Fusions" (Cohort study). FDA presented a comprehensive review of the medical literature, an analysis of the Cohort study conducted by the SIMG, and a summary of the clinical data that had been released by IDE sponsors. Presentations of two meta-analyses of the literature pertaining to the clinical performance of the device were given by spinal surgeons. In addition, 38 persons gave presentations during the public comment portion of the panel meeting. Patients who had had spinal fusion

surgery with pedicle screw instrumentation gave personal testimonies of their experiences with the device, citing both successes and failures. Several litigation attorneys, representing patients involved in class action lawsuits against spinal implant manufacturers, addressed the Panel with their views. Five spine surgeons gave their professional opinions regarding the usefulness of the pedicle screw device in their practices. Three surgeons representing spinal professional societies presented their societies' viewpoints.

At the conclusion of the July 22, 1994, meeting, the Panel recommended that FDA reclassify the generic type of device from class III into class II when intended for the treatment of degenerative spondylolisthesis and spinal trauma. The Panel recommended further that FDA adopt special controls as deemed necessary by FDA under 513(a)(1)(B) of the act, and that FDA assign a low priority for the establishment of a performance standard for this generic type of device under section 514 of the act (21 U.S.C. 360d).

Since 1986, a number of manufacturers have sought to demonstrate that the pedicle screw spinal system is a preamendments device, that is, that it was commercially available prior to May 28, 1976, the enactment date of the 1976 amendments. In a 510(k) dated December 22, 1994, Sofamor Danek, Inc., provided sufficient evidence of the preamendments commercial distribution of a spinal system that utilized pedicle screws. In a letter to Sofamor Danek, Inc., dated January 20, 1995, FDA acknowledged that sufficient evidence now exists documenting that pedicle screw spinal systems were commercially available prior to May 28, 1976. The preamendments pedicle screw spinal fixation device system consisted of hooks, spinal rods, threaded sacral rods, and pedicle screws connected to the rods with wire. The device was intended only for lumbar and sacral spine fusions using autogenous bone graft in patients with severe spondylolisthesis (grades 3 and 4) with removal of the device after spinal fusion was achieved. On January 20, 1995, the first postamendments pedicle screw spinal system was found to be substantially equivalent to the preamendments device. Based on this new information, FDA has determined that the pedicle screw spinal system is an unclassified preamendments device when indicated for autogenous bone graft fusions of the fifth lumbar vertebra to the sacrum in patients with severe spondylolisthesis (grades 3 and 4) at L<sub>5</sub>-

S<sub>1</sub> with removal of the device after fusion has been achieved. In a letter, dated April 3, 1995, FDA asked the Panel to provide its recommendations on the classification of this preamendments device. The Panel unanimously recommended that the preamendments pedicle screw spinal system be classified into class II when intended for autogenous bone graft fusions of the fifth lumbar vertebra to the sacrum in patients with severe spondylolisthesis (grades 3 and 4) at L<sub>5</sub>-S<sub>1</sub> with removal of the device after fusion has been achieved.

In this document, FDA is publishing the recommendations of the Panel with respect to classification of the preamendments device and reclassification of the postamendments device. FDA is also proposing to classify both the preamendments and postamendments devices into class II, and to codify them in one regulation.

### III. Recommendations of the Orthopedic and Rehabilitation Devices Panel

The Orthopedic and Rehabilitation Devices Panel, an FDA advisory panel, made the following recommendations regarding the classification of the pedicle screw spinal system:

(1) *Identification.* A pedicle screw spinal system is a multiple component device, made of alloys such as 316L stainless steel (Ref. 11), 316LVM stainless steel (Ref. 11), 22Cr-13Ni-5Mn stainless steel (Ref. 12), unalloyed titanium (Ref. 9), and Ti-6Al-4V (Ref. 10), that allows the surgeon to build an implant system to fit the patient's anatomical and physiological requirements. A spinal implant assembly consists of anchors (e.g., bolts, hooks, and screws); interconnection mechanisms incorporating nuts, screws, sleeves, or bolts; longitudinal members (e.g., plates, rods, and plate/rod combinations); and transverse connectors. The device is used primarily in the treatment of acute and chronic instabilities and deformities, such as trauma, tumor, or degenerative spondylolisthesis.

(2) *Classification recommendation.* Class II (special controls). The Panel recommended that the establishment of a performance standard be low priority.

(3) *Summary of reasons for recommendation.* The Orthopedic and Rehabilitation Devices Panel recommended that pedicle screw spinal systems be classified into class II because the Panel believed that general controls by themselves are insufficient to provide reasonable assurance of the safety and effectiveness of the device, but that there is sufficient information

to establish special controls to provide such assurance. The Panel also believed that premarket approval is not necessary to provide reasonable assurance of the safety and effectiveness of the device. The Panel believed that public information demonstrates that the risks to health have been characterized and can be controlled. The Panel also believed that the relationship between these risks and the device's performance parameters have been established and are sufficiently understood to assure the safety and effectiveness of the device. Furthermore, the Panel recognized that there exist voluntary standards and test methods with respect to the production of the device.

(4) *Summary of data on which the recommendation is based.* The Orthopedics and Rehabilitation Devices Panel based its recommendation on the Panel members' personal knowledge of, and clinical experience with, the device and presentations at the open panel meeting. The Panel noted that, based upon clinical data from the Cohort study, IDE clinical investigations, and the literature, pedicle screw spinal systems performed at least equivalent to, and in some instances superior to, currently available class II anterior and posterior spinal fixation devices, as well as to treatments not utilizing internal fixation devices for degenerative spondylolisthesis and trauma.

The Panel noted that, based on the Cohort study, clinical investigations under IDE protocols and studies available from the scientific literature, the use of pedicle screw spinal systems, when intended for the treatment of degenerative spondylolisthesis and spinal trauma, produced statistically significantly higher spinal fusion rates than when no fixation or nonpedicle screw spinal fixation was used. In addition, the Panel believed that these studies demonstrated statistically significant improvements in patients' clinical outcomes in terms of pain, function, and neurologic status. The Panel believed that these studies demonstrated significant technical and clinical advantages from the use of the device (Ref. 66).

According to the Panel, the mechanical testing data presented at the August 20, 1993, panel meeting demonstrated that pedicle screw spinal systems exhibit adequate mechanical strength, rigidity, and fatigue resistance for the expected length of time required to stabilize the spine to allow fusion to occur (Ref. 65).

The Panel concluded that the data presented at the July 22, 1994, panel meeting provided clinical evidence that the device was effective in stabilizing

the spine in spinal fusions for degenerative spondylolisthesis and spinal trauma. The Panel also determined that the incidence rates of device breakage, deformation, and loosening were similar to those of commercially available device systems and that the rates were clinically acceptable. The types of device-related complications for pedicle screw spinal systems reported to FDA under the MedWatch device reporting program were comparable to those reported in clinical studies and the medical literature for commercially available spinal systems and included broken screws, neurologic injuries, and nonunions (Ref. 66).

The Panel did not find support in the literature or in clinical data for use of the device in the treatment of low back pain. The Panel specifically recommended that low back pain should not be included in the indications for use of the device until clinical data justify its inclusion (Ref. 66).

The Panel believed that the primary risks to health associated with pedicle screw spinal systems are similar to those associated with other class II spinal implant devices. The Panel believed that both clinical and nonclinical parameters need to be controlled to provide reasonable assurance of the safety and effectiveness of the device. The primary nonclinical parameters affecting safety and effectiveness are: (1) Biocompatibility of the materials used in the manufacture of the device; (2) device design; (3) device durability; (4) device strength, and (5) device rigidity. The primary measures of clinical effectiveness of the device are: (1) Fusion, (2) pain relief, (3) functional improvement, and (4) neurologic status. These concerns are the same as those associated with commercially available class II devices, including posteriorly placed interlaminar spinal fixation orthoses (21 CFR 888.3050) and anteriorly placed spinal intervertebral body fixation orthoses (21 CFR 888.3060).

The Panel reviewed the medical literature pertaining to the use of pedicle screw spinal systems in the treatment of severe spondylolisthesis (Refs. 5, 6, 14, 27, 28, 29, 30, 48, 52, 68, 81, 82, 83, 84, 92, 93, 147, 155, 159, 168, 169, 175, and 188) and determined that the risks associated with the device are no different than those associated with the use of the preamendments class II spinal fixation devices or those associated with pedicle screw spinal systems intended for the treatment of other acute or chronic instabilities and deformities. The Panel concluded that

the effectiveness of the device is related to its mechanical strength and rigidity, which have been demonstrated to be superior to existing class II devices.

(5) *Risks to health.* The following risks are associated with the pedicle screw spinal system: (a) Mechanical failure. The screw may bend or fracture, loosen or pull-out, the plate or rod may bend or fracture, the connector may slip resulting in loss of fixation and loss of reduction; (b) soft tissue injury. The risks of tissue injury include screw over-penetration of the vertebral body with associated injury to major blood vessels or viscera; pedicle fracture; nerve root injury; spinal cord injury; cauda equina injury; dural tear or cerebrospinal fluid leak; blood vessel injury; and bowel injury; (c) pseudarthrosis. The risk of nonunion, or pseudarthrosis, signifies failure of bony fusion and persistent instability; and (d) need for reoperation. The risk of a possible reoperation includes reoperation for infection or bleeding; revision surgery; removal of device components for device failure, or symptomatic, painful, or prominent hardware; and reoperations for other reasons not related to fusion, such as nerve root decompression. In addition, there are theoretical risks, such as device-related osteoporosis, metal allergy, particulate debris, and metal toxicity, for which no reliable human data exist.

#### *A. Safety and Effectiveness: Nonclinical*

##### *1. Biocompatibility of Materials*

The biocompatibility of stainless steel and titanium metal alloys used in the fabrication of pedicle screw spinal systems has been investigated extensively with in vitro testing, implantation studies, mechanical testing, toxicological testing, corrosion testing, and clinical trials. These alloys have been demonstrated to be reasonably safe for human usage under a variety of conditions. (Refs. 23, 33, 67, 105, 111, 134, 135, 179, 180, 182, and 197).

Stainless steels, such as 316 L, 316 LVM, and 22Cr-13Ni-5Mn alloys, are susceptible to some degree of crevice, pitting, and stress corrosion. The presence of corrosion products can produce a localized chronic inflammatory response with granuloma formation, macrophage engorgement with particulate matter, and focal areas of necrosis (Refs. 41, 67, 76, 111, 167, 179, and 197). Metallic ion species from leaching or corrosion can produce allergic responses (Refs. 61, 67, 120, and 148). These are recognized and well-described tissue reactions to stainless steel implants and metal ions.

Nevertheless, stainless steels have been used extensively with great clinical success for the fabrication of surgical implants, including bone plates, bone screws, and intramedullary rods. The biocompatibility of stainless steels has been regarded as acceptable for implants at various anatomic locations under different pathophysiological conditions (Refs. 38, 67, 105, 134, 135, 157, 158, 165, 179, and 181).

The corrosion resistance of commercially pure (CP) titanium and Ti-6Al-4V alloy has been well-documented through in vitro testing, implantation studies, toxicological testing, corrosion testing, and clinical trials. Titanium and its alloys are susceptible to wear as well as corrosion, and thus may cause black discoloration of surrounding tissues and induce aseptic local fibrosis (Refs. 33, 42, 115, 121, 129, 139, 197, and 198). In the soft tissue surrounding titanium alloy orthopedic implants, T-lymphocytes in association with macrophages have been observed, implying an immunological response to the debris (Ref. 103). Macrophage release of bone-resorbing mediators in association with titanium wear debris has also been demonstrated (Ref. 85). The significance of these observations regarding the biologic and toxicologic effects of titanium ions and wear particles in spinal fusion is uncertain since these tissue reactions have been observed only in closed joint systems, such as hip replacements (Refs. 121 and 129). Despite these tissue responses, CP titanium and titanium alloys are still considered relatively safe biomaterials, and may be effectively used with minimal risk when not used as the articulating surface, which leads to the generation of large amounts of wear debris (Refs. 42, 121, 129, 139, 196, 197, and 198). Titanium and its alloys have been used extensively as implant materials since the mid-1960's for the fabrication of implants such as bone plates, bone screws, and hip implants (Refs. 105, 129, 182, 196, 197, and 198).

All available metallic implant materials are imperfect biomaterials. In the trade-off between the theoretical risks arising from metal ion release, corrosion products, and wear debris, and the known benefits of these materials, it appears that both stainless steel and titanium alloys are acceptable for human implantation in the spinal environment.

The Panel believed that the biocompatibility specifications of existing voluntary standards provide reasonable assurance of the safety and effectiveness of devices manufactured of

metals and metallic alloys (Refs. 65 and 66).

## 2. Mechanical Properties of the Device

It has been demonstrated that the multiple component pedicle screw spinal systems perform as well as other commercially available spinal fixation device systems in various modes and frequencies of loading (Refs. 8, 21, 45, 63, 67, 71, 73, 77, 98, 99, 100, 136, 137, 138, 142, 143, 144, 146, and 184).

Sufficient test methods exist to enable the evaluation of fatigue strengths and tensile, torsional, and bending strengths of the pedicle screw spinal fixation systems to assure its safety and effectiveness during the period of time needed for fusion to occur (Refs. 8, 13, 21, 45, 66, 72, and 78). There is adequate mechanical testing data for the pedicle screw spinal system for which clinical data was presented at the July 22, 1994, panel meeting. For example, one of the pedicle screw-plate systems had a static bending strength of 807.8 N, stiffness of 123.7 KN/M, and flexibility of  $8.18 \times 10^{-3}$  M/KN (Ref. 45). In cyclic fatigue testing, the same system endured  $10^6$  cycles with a 400 N load,  $10^6$  cycles with a 500 N load, and 212,960 cycles with a 600 N load (Ref. 45). Pedicle screw-rod systems have reported static bending strengths ranging from 544.9 to 1,289 N, stiffnesses ranging from 136.9 to 153.2 KN/M, and flexibilities ranging from 6.53 to  $7.32 (\times 10^{-3})$  M/KN (Ref. 45). In cyclic fatigue testing, the pedicle screw-rod fixation device systems have endured  $10^6$  cycles with a 400 N load, 202,769 to  $10^6$  cycles with a 500 N load, and 135,017 to 799,544 cycles with a 600 N load (Ref. 45).

### B. Safety and Effectiveness: Clinical

The Panel based its recommendations on valid scientific evidence from the Cohort study, IDE clinical investigations, and the medical literature. These data sources allowed the Panel to evaluate the safety and effectiveness of pedicle screw spinal systems in terms of mechanical failure, soft tissue injury, pseudarthrosis, reoperation, fusion, pain, function, and neurologic status, as well as other potential harmful and beneficial effects of these devices.

Representatives of the SIMG presented the results of the Cohort study at the July 22, 1994, panel meeting. The Cohort study was an open, nonblinded, historical cohort study (Ref. 201). It was designed to recruit a maximum number of surgeons who would voluntarily participate by collecting clinical data on patients who had undergone spinal fusions. Physicians were recruited through announcements at professional

society meetings and direct mailings to professional society memberships. Clinical data were collected from medical records of patients who had undergone spinal fusions during the period January 1, 1990, to December 31, 1991. This window was chosen to allow an adequate number of patients with a theoretical minimum followup of 2 years up to the time of the study onset. The concurrent control groups consisted of patients with identical entry criteria who had been operated on during the same time window (1/1/90–12/31/91). These control patients were either fused without instrumentation (noninstrumented) or were fused and instrumented with a control device (nonpedicle screw instrumentation). The data collection protocol was identical to that used for the study group.

Three hundred fourteen surgeons voluntarily participated in this study and contributed a total of 3,500 patients: 2,685 patients in the Degenerative Spondylolisthesis group and 815 patients in the Fracture (spinal trauma) group. In the Degenerative Spondylolisthesis group, the 2,685 patients were stratified by treatment: 2,177 patients were treated with pedicle screw instrumented fusions, 51 patients with nonpedicle screw instrumented fusion, and 457 patients with noninstrumented fusion. Similarly, in the Fracture group, the 815 patients were stratified by treatment: 587 patients were treated with pedicle screw instrumented fusions, 221 patients with nonpedicle screw instrumented fusion, and 7 patients with noninstrumented fusion.

Data from three clinical evaluation periods were collected from each patient record: Preoperatively, immediately postoperatively, and at the final evaluation which ranged from six months to two years postoperatively. The preoperative data included the patient's age, gender, weight, primary diagnosis, involved levels, identification of known prognostic variables (e.g., prior back surgery), and levels of pain, function, and neurologic status. Information regarding the operative procedure included the date of operation, type of bone grafting (if any), the levels instrumented and fused, the name of the pedicle screw device, and the number of each of the relevant components (e.g., rods, screws, connectors). Data collected at the final evaluation time point included the date of the last clinical and radiographic evaluations; fusion status; the date fusion was first diagnosed; maintenance of alignment; and neurologic, functional, and pain assessments.

Intraoperative and postoperative adverse events and the incidence and cause of reoperations were recorded.

Ten prospective IDE clinical trials for multiple indications were analyzed. Five studies involving the treatment of degenerative spondylolisthesis ( $n = 268$ ) and two studies involving the treatment of spinal fracture ( $n = 27$ ) were compared to the results of the Cohort study and were presented to the Panel (Ref. 66).

A comprehensive search of the English-language medical literature from 1984 to the present was performed. One hundred one articles pertained to clinical performance of pedicle screw devices and were selected for inclusion in this review (Ref. 66). Only articles appearing in peer-reviewed journals were included. Meta-analyses of the medical literature for degenerative spondylolisthesis and spinal trauma were conducted and presented (Refs. 51, 66, and 119).

These data were analyzed and presented at the July 22, 1994, panel meeting.

### 1. Mechanical Failure

The Cohort study provided the incidence of mechanical device failures related to treatment with pedicle screw spinal systems, nonpedicle screw instrumentation, and noninstrumented fusion (Refs. 66 and 201). For the fracture group ( $n = 586$ ), the pedicle screw group had a mechanical failure rate of 9.7 percent, compared to a 1.9 percent failure rate in the nonpedicle screw group. For the pedicle screw group, the incidence of screw fracture was 6.7 percent, screw loosening 2.1 percent, rod/plate fracture 0.3 percent, and connector loosening (slippage) 0.2 percent. For the nonpedicle screw group ( $n = 221$ ), the incidence of rod/plate fracture was 0.9 percent, hook pull-out 0.5 percent, and connector slippage 0.5 percent.

For the degenerative spondylolisthesis group, the device mechanical failure rate was 7.8 percent in the pedicle screw group ( $n = 2,153$ ). The most frequent events for the pedicle screw group were screw loosening (2.8 percent), screw fractures (2.6 percent), rod or plate fractures (0.7 percent), and connector loosening (slippage) (0.7 percent). Mechanical device failures were not possible in the noninstrumented group because a surgical technique, not an instrument technique, was utilized.

The overall incidence of mechanical device failures in the IDE clinical investigations ( $n = 2,431$ ) was 0.7 to 3.7 percent (mean = 1.2 percent) (Ref. 66). For all investigational pedicle screw

spinal systems reported, the incidence of rod/plate fractures for degenerative spondylolisthesis was 0.0 to 7.1 percent (mean = 1.5 percent), for fractures 0.0 percent, for degenerative disc disease 0.0 to 4.0 percent (mean = 1.1 percent), for scoliosis 0.0 to 9.1 percent (mean = 0.9 percent), for failed back syndrome 0.0 to 2.7 percent (mean = 0.3 percent), and for spinal stenosis 0.0 to 7.7 percent (mean = 5.0 percent) (Ref. 66). The incidence of screw fractures for degenerative spondylolisthesis was 0.0 to 18.6 percent (mean = 6.2 percent), for fractures 20.0 to 28.6 percent (mean = 22.2 percent), for degenerative disc disease 0.0 to 2.7 percent (mean = 0.6 percent), for scoliosis 1.8 percent, for failed back syndrome 0.0 to 3.4 percent (mean = 2.4 percent), and for spinal stenosis 0.0 to 14.3 percent (mean = 3.0 percent). The incidence of screw loosening or pull-out for degenerative spondylolisthesis was 0.0 to 9.3 percent (mean = 0.9 percent), for fractures 0.0 to 5.0 percent (mean = 3.7 percent), for degenerative disc disease 0.0 to 7.4 percent (mean = 0.7 percent), for scoliosis 0.0 to 3.5 percent (mean = 1.8 percent), for failed back syndrome 0.0 to 12.1 percent (mean = 1.6 percent), and for spinal stenosis 0.0 percent. The incidence of connector loosening was 0.0 percent for degenerative spondylolisthesis, fractures, scoliosis, and spinal stenosis, 0.0 to 2.1 percent (mean = 0.4 percent) for degenerative disc disease, and 0.1 percent for failed back syndrome.

A low rate of mechanical failure of pedicle screw fixation devices, when used in multiple indications, is further documented by the medical literature (Refs. 3, 5, 19, 22, 24, 32, 35, 37, 43, 47, 50, 58, 59, 60, 73, 77, 79, 87, 89, 90, 94, 95, 107, 109, 110, 113, 116, 122, 125, 150, 151, 152, 162, 163, 164, 173, 183, 185, 186, 187, 191, 192, 193, and 203). A meta-analysis of 58 clinical studies revealed no differences between pedicle screw fixation (n = 641), hook-rod fixation (n = 1128), anterior fixation (n = 255), and sublaminar wire-rod fixation (n = 48) groups in the rate of mechanical device failures (Refs. 51 and 119).

Survivorship analysis of pedicle screw device failures (defined as screw bending or breaking, infection, device loosening, rod or plate hardware problems, or neurologic complication requiring device removal) in patients treated for spondylolisthesis, postlaminectomy instability, pseudarthrosis, trauma, scoliosis, and tumor demonstrated a 90 percent survival of the instrumentation at 20 months, and 80 percent survival at 5 to 10 years (Ref. 124). The cumulative survivorship at 1 year was 84.0 percent

and 91.3 percent for two devices used in the treatment of patients diagnosed with degenerative isthmic spondylolisthesis, degenerative segmental instability, and degenerative lumbar scoliosis (Ref. 26). Survivorship analysis performed on thoracolumbar burst fractures treated with pedicle screw fixation also demonstrated high survival rates for the implants: 100 percent at 22.4 months and 75 percent from 22.4 to 32 months (54).

## 2. Soft Tissue Injury

The incidence of device-related soft tissue injuries associated with the use of pedicle screw spinal systems for both degenerative spondylolisthesis and fracture groups is comparable to that associated with nonpedicle screw instrumented fusions and noninstrumented fusions (Refs. 66 and 201). Clinical studies have documented 0.1 percent and 0.2 percent rates of vascular injuries related to the use of pedicle screw spinal systems for the degenerative spondylolisthesis and fracture groups, respectively, and no visceral (intestinal) injuries for those groups. There were no differences found between treatment groups for intraoperative and postoperative neurological injuries, including nerve root and spinal cord injuries, as well as new radicular pain. For the degenerative spondylolisthesis and fracture groups, intraoperative nerve root injuries occurred in 0.4 percent and 0.2 percent of cases, respectively; intraoperative spinal cord injuries occurred in 0.1 percent and 0.2 percent of cases, respectively; postoperative radicular pain or deficits in 4.8 percent and 0.9 percent of cases, respectively; intraoperative device-related dural tears in 0.1 percent and 0.7 percent of cases, respectively; and postoperative dural tears or leaks in 0.3 percent and 0.0 percent of cases, respectively (Refs. 66 and 201).

The data released from the IDE clinical investigations reported an overall vascular injury rate of 0.7 percent; an intraoperative nerve root injury rate of 0.1 percent; a wound infection rate of 3.7 percent; a postoperative radicular pain or deficit rate of 2.2 percent; and a rate of postoperative dural tears or leaks of 0.8 percent. In these investigations, intraoperative spinal cord injuries did not occur (Ref. 66).

The medical literature documents a low incidence of soft tissue injuries related directly to the device when used in the treatment of fractures (Refs. 46, 49, 74, 106, 127, and 153), degenerative spondylolisthesis (Refs. 26, 27, 37, 49, 60, 113, 183, 185, 187, 191, and 192),

isthmic spondylolisthesis (Ref. 147), degenerative disc disease (Refs. 47, 60, 113, 183, 187, 191, and 192), deformities (Ref. 25), scoliosis (Refs. 43 and 116), tumors (Ref. 126), spinal stenosis (Ref. 173), and multiple diagnoses (Refs. 112 and 122). A meta-analysis of the medical literature for treatment of degenerative spondylolisthesis and fracture demonstrates no differences in the rates of intraoperative and postoperative adverse events related to soft tissue injuries among pedicle screw fixation, hook-rod fixation, anterior fixation, and sublaminar wire-rod fixation treatment groups (p < 0.05) (Refs. 51 and 119).

These soft tissue injuries appear to be related to the surgical procedure, rather than the device itself. Misdirected pedicle screws can cause pedicle fracture, screw cutout, or screw penetration of the pedicle, potentially causing nerve root or spinal cord injuries, dural tears, or canal stenosis (Refs. 152, 166, 171, and 189). Meticulous surgical technique and attention to detail appear to minimize these adverse events (Refs. 24, 47, 60, 79, 90, and 190). Pedicle screws too large for the pedicle diameter can cause pedicle fracture. Likewise, over penetration of pedicle screws through the vertebral body from pedicle screws too long for the anterior-posterior dimensions of the vertebrae can cause retroperitoneal vascular or visceral injury (Refs. 101, 106, and 204). Thus, selection of the appropriate size of the pedicle screw is critical to prevent these injuries (Refs. 64 and 190). Operative technique guidelines have been developed to assure accurate placement of pedicle screws and minimize operative complications (Refs. 16, 56, 149, 164, and 172). In addition, the relevant surgical anatomy of the thoracic, lumbar, and sacral spine, including the pedicle dimensions and orientation, as well as surrounding soft tissue structures, have been thoroughly described in the medical literature (Refs. 7, 15, 20, 57, 62, 64, 69, 75, 87, 88, 91, 101, 102, 106, 117, 131, 132, 133, 141, 145, 156, 161, 166, 171, 176, 177, 189, 190, 195, 199, and 204).

## 3. Pseudarthrosis

In the Cohort study, radiographic data were available to determine the fusion status for 1,794 patients in the pedicle screw group and 382 patients in the noninstrumented group for the treatment of degenerative spondylolisthesis, and 506 patients in the pedicle screw group and 184 patients in the nonpedicle screw group for the treatment of fracture. There was a statistically significant reduction in

the incidence of pseudarthrosis in the degenerative spondylolisthesis group when treated with pedicle screw fixation (3.7 percent) compared to treatment without instrumentation (17.0 percent) ( $p < 0.001$ ). However, there was no significant difference in the incidence of pseudarthrosis associated with the use of pedicle screw fixation in treating fractures (1.8 percent) compared to treatment with nonpedicle screw fixation devices (3.3 percent) ( $p = 0.18$ ) (Refs. 66 and 201).

In the data released from the IDE clinical investigations, the incidence of pseudarthrosis for degenerative spondylolisthesis was 0.0 to 44.0 percent (mean = 12.6 percent), for fractures 10.0 to 14.3 percent (mean = 11.1 percent), for degenerative disc disease 0.0 to 37.0 percent (mean = 8.4 percent), for scoliosis 0.0 to 36.4 percent (mean = 3.7 percent), for "failed back syndrome" 0.0 to 47.2 percent (mean = 12.6 percent), and for spinal stenosis 5.1 to 14.3 percent (mean = 13.0 percent) (Ref. 66).

The medical literature similarly documents a low incidence of pseudarthrosis in those treated with pedicle screw spinal systems for fractures (Refs. 3, 17, 34, 35, 36, 47, 80, 153, and 154), degenerative spondylolisthesis (Refs. 32, 37, 96, 125, 173, and 174), deformities (Ref. 25), degenerative spondylosis (Refs. 22, 24, 169, and 194), degenerative disc disease (Ref. 205), and tumor (Refs. 50 and 126). Survivorship analysis for pseudarthrosis demonstrated a 98 percent fusion rate at one year, 97 percent at 12 to 20 months, 96 percent at 21 to 30 months, and 93 percent at 31 to 40 months (Ref. 124).

#### 4. Reoperation

Reoperations were necessary in 17.6 percent and 23.2 percent of cases, respectively, for the degenerative spondylolisthesis and fracture groups in the Cohort study (Refs. 66 and 201). Device removals constituted the vast majority of reoperation procedures: 270 of 379 (71.2 percent) patients with reoperations in the degenerative spondylolisthesis group, and 109 of 136 (80.1 percent) patients with reoperations in the fracture group. Most device removals were performed for pain, irritation, or prominence of the device (6.3 percent and 7.2 percent in the degenerative spondylolisthesis and fracture groups, respectively). Only a small percentage of the devices were removed for device failure (0.6 percent and 1.5 percent in the degenerative spondylolisthesis and fracture groups, respectively).

In the data released from the IDE clinical investigations, the rates of

reoperations reported for degenerative spondylolisthesis were 1.4 to 13.2 percent (mean = 5.0 percent), for fractures 10.0 to 14.3 percent (mean = 11.1 percent), for degenerative disc disease 1.4 to 10.5 percent (mean = 2.3 percent), for scoliosis 2.3 percent, for failed back syndrome 1.1 to 8.8 percent (mean = 1.6 percent), and for spinal stenosis 5.1 to 5.6 percent (mean = 5.0 percent) (Ref. 66). The medical literature documents rates of device-related and nondevice related reoperations of 7.0 percent to 24 percent for pedicle screw fixation cases for a variety of conditions (Refs. 50, 60, 86, and 173). Meta-analysis of the literature demonstrated that the reoperation rate for the treatment of fractures with pedicle screw spinal systems (5.8 percent) are comparable to the reoperation rates associated with hook-rod devices (8.9 percent) and anterior devices (2.7 percent) (Refs. 51 and 119).

#### 5. Fusion

Comparing the degenerative spondylolisthesis and fracture groups in the Cohort study, patients treated with pedicle screw fixation had a significantly higher fusion rate (89.1 percent and 88.5 percent, respectively) than the nonpedicle (70.8 percent and 81.0 percent) and noninstrumented (70.4 percent and 50.5 percent) groups ( $p < 0.0001$ ). Using actuarial analysis, the time-adjusted rates of fusion for the degenerative spondylolisthesis group demonstrated that treatment with pedicle screw fixation was associated with a significantly greater rate of fusion than treatment with no instrumentation (82.5 percent versus 74.5 percent,  $p < 0.001$ ). The time-adjusted rates of fusion for the fracture patient group demonstrated that there was no significant difference in the rates of fusion when comparing pedicle screw fixation and nonpedicle screw fixation. For the degenerative spondylolisthesis group, the rate of fusion was higher in those treated with pedicle screw fixation than in those treated without instrumentation at every time interval beyond 3 months. These rates are evidence that fusion occurs faster in the pedicle group (Refs. 66 and 201).

In the data released from clinical investigations performed under IDE's, fusion rates associated with pedicle screw spinal systems were comparable to those associated with nonpedicle screw instrumentation and noninstrumentation. The fusion rates in patients with pedicle screw fixation were 82.1 to 89.5 percent (mean = 87.8 percent) in the treatment of degenerative spondylolisthesis, 71.4 to 80.0 percent (mean = 77.8 percent) for fractures, 82.9

to 93.1 percent (mean = 85.9 percent) for degenerative disc disease, 96.5 percent for scoliosis, 88.6 to 94.7 percent (mean = 91.9 percent) for "failed back syndrome," and 85.7 to 92.3 percent (mean = 91.3 percent) for spinal stenosis (Ref. 66).

A high incidence of successful fusion after pedicle screw fixation is documented in the medical literature. The fusion rates for the treatment of spinal deformity was 100 percent (Ref. 86); for low back syndrome 100 percent (Ref. 109); for postlaminectomy instability 94 percent (Ref. 113); for fracture 88.5 percent to 100 percent (Refs. 55, 66, 80, and 201); for postsurgical failed back syndrome 91.6 percent (Ref. 173); for pseudarthrosis 80 percent to 94 percent (Refs. 113 and 186); for degenerative spondylosis 87 percent to 100 percent (Refs. 22, 169, 185, and 187); for spinal stenosis 96 percent to 100 percent (Refs. 113, 163, and 173); for scoliosis 100 percent (Ref. 163); for spondylolisthesis 78 percent to 100 percent (Refs. 27, 37, 49, 96, 113, 125, and 173); and for multiple diagnoses 77 percent to 100 percent (Refs. 49, 95, 110, 183, 192, 200, and 202). A randomized prospective trial comparing pedicle screw fixation with noninstrumented fusion demonstrated a significant improvement in the rate of successful fusion when pedicle fixation was utilized (94 percent fusion rate with rigid pedicle screw instrumentation versus 65 percent without instrumentation) (Ref. 202).

Meta-analyses of the medical literature compared the treatment outcomes with pedicle screw fixation with three types of class II spinal fixation systems, i.e., posterior hook-rod devices, anterior instrumentation, and sublaminar wire-rod instrumentation. For thoracolumbar spine fractures, patients treated with pedicle screw fixation had a significantly higher rate of successful fusion (99.4 percent) than those treated with hook-rod fixation (96.9 percent) or anterior fixation (94.8 percent),  $p < 0.05$  (Ref. 51). There were no significant differences in the fusion rates for patients with degenerative spondylolisthesis treated with pedicle screw fixation (93 percent) and those treated with hook-rod/sublaminar wire-rod fixation (96 percent) or anterior fixation (94 percent) (Ref. 119).

#### 6. Pain

For the degenerative spondylolisthesis patients in the Cohort study, the rate of improvement in back pain was significantly greater in the pedicle group (91.5 percent) when compared to the noninstrumented group (84.0 percent),  $p < 0.001$ . In contrast, the

rate of back pain improvement was greater in the nonpedicle group (95.2 percent) than the pedicle group (90.1 percent) for the fracture patient group,  $p < 0.023$ . The rate of improvement in leg pain was significantly greater in those degenerative spondylolisthesis patients treated with pedicle screw fixation (91.5 percent) than those treated without instrumentation (88.2 percent),  $p < 0.027$ . There were comparable improvements in pain in patients treated with pedicle screw fixation (90.1 percent) and nonpedicle screw instrumented fusion (95.2 percent) for the fracture patient group (Refs. 66 and 201).

Clinical investigations performed under IDE protocols have demonstrated rates of improvement in pain ranging from 79.1 to 89.3 percent (mean = 85.7 percent) in the treatment of degenerative spondylolisthesis, 70.0 to 85.0 percent (mean = 74.1 percent) for fractures, 71.7 to 86.2 percent (mean = 78.2 percent) for degenerative disc disease, 44.2 percent for scoliosis, 72.4 to 81.6 percent (mean = 76.8 percent) for failed back syndrome, and 71.4 to 84.6 percent (mean = 82.6 percent) for spinal stenosis (Ref. 66).

The medical literature also documents successful outcomes for pain in patients treated with pedicle screw fixation with success rates ranging from 67 percent to 100 percent (Refs. 2, 19, 27, 37, 80, 86, 95, 97, 109, 110, and 147). A meta-analysis of these data showed that the 83.3 percent rate of improvement in pain for patients treated with pedicle screw instrumentation was comparable to the 83.3 percent rate for hook-rod instrumentation and the 77.0 percent rate for anterior instrumentation in the treatment of fractures (Ref. 51). Similarly, the rate of satisfactory clinical (pain and function) outcomes in patients treated for degenerative spondylolisthesis with pedicle screw instrumentation was 85.7 percent, which was comparable to those treated with nonpedicle screw instrumentation (89.6 percent) or noninstrumented fusions (89.6 percent) (Refs. 51 and 119).

#### 7. Function

In the Cohort study, data on functional status was available from 2,132 patients in the pedicle screw group and 451 patients in the noninstrumented group for the treatment of degenerative spondylolisthesis, and from 569 patients in the pedicle screw group and 211 patients in the nonpedicle screw group for the treatment of fracture. In the degenerative spondylolisthesis group, there was a significantly greater

incidence of functional improvement associated with the use of pedicle screw fixation (90.4 percent) compared to treatment without instrumentation (86.7 percent) ( $p < 0.02$ ). In contrast, in the fracture group, there was a significantly lower incidence of functional improvement associated with the use of pedicle screw fixation (87.9 percent) compared to treatment with nonpedicle screw fixation (93.4 percent) ( $p < 0.027$ ) (Refs. 66 and 201).

In the IDE clinical investigations, the rate of functional status improvement for degenerative spondylolisthesis treated with pedicle screw instrumentation was 79.1 to 86.8 percent (mean = 84.4 percent), fractures 75.0 to 85.7 percent (mean = 77.8 percent), degenerative disc disease 74.1 to 75.7 percent (mean = 75.4 percent), scoliosis 34.9 percent, failed back syndrome 69.3 to 73.6 percent (mean = 71.6 percent) and spinal stenosis 71.4 to 74.4 percent (mean = 73.9 percent) (Ref. 66).

In the medical literature, the rate of successful functional outcomes in the treatment of spinal stenosis was 78 percent (Ref. 173); isthmic spondylolisthesis 90.9 percent (Ref. 147); postsurgical failed back syndrome 80.2 percent (Ref. 173); degenerative disc disease 60 percent (Ref. 206); and low back pain 72 percent (Ref. 109). A meta-analysis of these data showed that the 82.0 percent rate of improvement in functional outcomes of patients treated with pedicle screw instrumentation was comparable to the 74.8 percent rate for hook-rod instrumentation and the 73.2 percent rate for anterior instrumentation in the treatment of fractures (Ref. 51).

#### 8. Neurologic Status

In the Cohort study, in the degenerative spondylolisthesis group, the rate of improvement of spinal cord neurologic function was comparable for those treated with pedicle screw fixation (3.6 percent) and those treated with noninstrumented fusion (1.2 percent). For the fracture group, there were no significant differences in the rates of improvement of spinal cord neurological assessments between the pedicle screw (13.3 percent) and nonpedicle screw instrumentation (13.0 percent) groups ( $p < 0.91$ ) (Refs. 66 and 201).

For the degenerative spondylolisthesis group, the rate of root status improvement by one grade or more was significantly greater in patients treated with pedicle screw fixation (36.8 percent) than in patients treated without instrumentation (29.2 percent), or with nonpedicle screw fixation (25.5 percent),  $p < 0.002$ . In the

fracture group, the rates of improvement in root neurological assessments were comparable in the pedicle screw instrumented group (24.1 percent) and the nonpedicle screw instrumented group (18.2 percent) ( $p < 0.08$ ) (Refs. 66 and 201).

In the IDE clinical investigations, there was improved neurological root status in 11.8 to 32.6 percent of patients (mean = 19.3 percent) with degenerative spondylolisthesis, in 7.5 to 30.7 percent of patients (mean = 17.6 percent) with degenerative disc disease, in 12.2 to 32.2 percent of patients (mean = 20.5 percent) with failed back syndrome, in 5.8 percent of patients with scoliosis, in 28.6 percent of patients with spinal stenosis, and in 14.3 percent of patients with fracture (Ref. 66).

Improvement in the neurological status of patients treated with pedicle screw fixation in the medical literature ranged from 18.8 percent to 100 percent, and was found to be comparable to that resulting from nonpedicle screw instrumented fusions and noninstrumented fusions (Refs. 39, 49, 55, 80, 107, 153, 154, and 164). Meta-analysis of the literature for the treatment of thoracolumbar fractures demonstrated a statistically higher rate of neurologic improvement in the anterior instrumentation (51.4 percent) and hook-rod instrumentation (40.7 percent) treatment groups compared to the pedicle screw instrumentation group (24.3 percent) ( $p < 0.05$ ). However, the pedicle screw treatment group had a significantly greater proportion of neurologically intact (Frankel E) preoperative neurological profiles compared to all other treatment groups and, hence, no potential for neurological recovery (Ref. 51). There were no significant differences between treatment groups in the number of patients who were neurologically worse or who had neurological complications (Ref. 51).

#### 9. Potential Effects on Bone Density

Experimental work has demonstrated decreased pedicle screw fixation strength in bone with decreased bone mineral density (Refs. 40 and 167), and care must be taken, therefore, in patients with osteoporosis (Ref. 170). Animal studies have demonstrated significant device-related decrease in bone density following arthrodesis with rigid spinal instrumentation (Ref. 123). However, rates of successful fusion increase with increased mechanical rigidity of the spinal fixation systems used to stabilize the spine. The significance of these findings in the clinical setting has not been resolved.



#### 10. Potential Benefits of Pedicle Screw Spinal Systems

The number of motion segments in fracture patients that were required to be fused when using pedicle screw fixation has been reported to be half that required when using hook-rod and sublaminar wire-rod instrumentation (Refs. 77, 109, 154, and 203). This reduction in the number of spinal segments fused preserves motion at the adjacent motion segments, particularly at the important caudal levels of the spine. In these same publications, the authors reported that, when using pedicle screw spinal systems, the frequency of disc degeneration at levels adjacent to the fused segments was found to occur at rates comparable to those occurring in hook-rod and sublaminar wire-rod instrumentation systems.

The rigid, segmental, three-column fixation achieved with pedicle screw fixation allowed successful fixation of severely unstable spines in cases of tumor (Refs. 31, 77, 94, and 114), severe fracture-dislocation (Refs. 2, 4, 17, 35, 46, 53, 58, 59, 73, 107, 108, 128, 130, 140, 153, 154, 160, and 178), deformities (Ref. 25), pseudarthrosis (Ref. 104), severe spondylolisthesis (Refs. 27, 77, and 175), and instability following extensive laminectomy (Refs. 113 and 118). Two authors reported that posterior distraction achievable with pedicle screw instrumentation may allow greater fracture reduction and spinal canal decompression, and may improve neurological recovery (Refs. 70 and 203).

#### IV. FDA's Tentative Findings

FDA agrees with the Orthopedic and Rehabilitation Devices Panel's recommendation and is proposing that the pedicle screw spinal system intended for the treatment of degenerative spondylolisthesis, severe spondylolisthesis, and spinal trauma be classified into class II. FDA believes that there exists sufficient information to develop special controls which will provide reasonable assurance of the safety and effectiveness of these devices. FDA believes that appropriate special controls should include mechanical testing standards of performance, special labeling requirements, and postmarket surveillance. FDA also believes that premarket approval is not necessary to provide reasonable assurance of the safety and effectiveness of the device.

The data demonstrate that the use of pedicle screw-based instrumentation in the treatment of degenerative spondylolisthesis and fractures results

in significantly higher fusion rates, improved clinical outcomes, and comparable complication rates when compared with treatment with no instrumentation or with currently available preamendments class II spinal devices (see section III.B. of this document).

The data also demonstrate that the use of pedicle screw-based instrumentation in the treatment of severe spondylolisthesis results in equivalent or higher fusion rates, similar clinical outcomes, and comparable complication rates when compared with treatment with no instrumentation or with currently available preamendments class II spinal devices (Refs. 5, 6, 14, 27, 28, 29, 30, 48, 52, 68, 81, 82, 83, 84, 92, 93, 147, 155, 159, 168, 169, 175, and 188).

#### V. Summary of Data Upon Which FDA's Findings are Based

##### A. Clinical and Mechanical Data

FDA analyzed the medical literature pertaining to pedicle screw spinal systems and presented its findings at the July 22, 1994, advisory panel meeting (Ref. 66). The literature pertaining to the clinical performance of pedicle screw spinal systems is extensive and describes clinical indications for use, descriptions of surgical techniques, definitions of clinical endpoints and outcome variables used to evaluate safety and effectiveness, and descriptions of the types, and estimates of the frequencies, of device-related complications. The literature pertaining to the mechanical characteristics of pedicle screw-based spinal instrumentation is also extensive and provides considerable data on the device materials, strength, and other mechanical characteristics of the device (see section II.A.2. of this document).

Review of publicly released IDE clinical investigation data from annual reports (Ref. 65), as well as data released by the study sponsors (Ref. 66), provided FDA clinical data from controlled investigations on clinical and radiographic outcomes, fusion rates, and device-related complication rates.

Review of the MedWatch and Medical Device Reporting (MDR) data bases, FDA's device problem reporting systems, provided information regarding the types of device-related complications associated with the use of spinal instrumentation devices. The complications associated with pedicle screw spinal systems reported to FDA were comparable to those associated with the use of commercially available class II spinal fixation devices (Ref. 66).

The Cohort study data, submitted to the agency by the Scientific Committee and presented to the panel at the July 22, 1994, meeting, provided data from a large cohort of patients with spinal fusions (Refs. 66 and 201). FDA evaluated the Cohort study and identified a number of shortcomings in the study design. FDA found that the Cohort study design has weaknesses inherent in all retrospective studies, including concerns of possible selection bias; comparability of the treatment groups; differences in the diagnostic inclusion criteria; treatment differences, including differences in surgeon skill and experience, surgical procedures, devices, and postoperative care; differences in outcome measurement and reporting; and the degree of completeness of medical records (Ref. 66). In addition, FDA found that a significant number of cases did not complete the 2-year followup period required for IDE clinical trials and that several issues regarding the pooling of data were not addressed (Ref. 66). However, many of these weaknesses were anticipated in the planning phase of the study and steps were taken to minimize these potential problems.

FDA has determined that, despite its weaknesses, the Cohort study was conducted in a scientifically sound manner (Ref. 66). The investigation provided adequate numbers of cases, followup times, clinical performance data, and complication rate data to permit assessment of the safety and effectiveness of the device. In addition, FDA has determined that the data meet the criteria for valid scientific evidence found in 21 CFR 860.7(c)(2), that is, they are from partially controlled studies, studies and objective trials without matched controls, well-documented case histories conducted by qualified experts, and reports of significant human experience with a marketed device, from which it can fairly and responsibly be concluded by qualified experts that there is reasonable assurance of the safety and effectiveness of a device under its conditions of use. Under this regulation, the evidence may vary according to the characteristics of the device, its conditions of use, the existence and adequacy of warnings and other restrictions, and the extent of experience with its use.

FDA recognizes that the design and intent of the Cohort study was to investigate two demanding clinical situations rather than merely two diagnostic groups. The investigation of this device for these two diagnostic entities constituted a "worst case scenario." FDA has concluded that these entities represented the extremes

of acute and chronic instabilities and deformities. Therefore, FDA had strongly recommended that the study design be limited to degenerative spondylolisthesis and spinal fracture in order to produce a more meaningful investigation (Ref. 66). These entities were well-recognized and easily definable diagnoses with established radiographic findings, clinical symptomatology, surgical indications, and treatment outcomes. These two diagnoses were expected to yield homogeneous patient groups in terms of recognized prognostic variables. More importantly, these diagnostic groups were recognized to be mechanically demanding and clinically challenging situations that would rigorously test the device. The fracture group, which included fractures and fracture-dislocations, represented the extreme of spinal instability, and was often accompanied by neurologic deficit, deformity, pain, and severe functional loss. The degenerative spondylolisthesis group represented chronic instability with deformity from degenerative disease.

FDA believes that the following special controls, in combination with the general controls applicable under the act, would provide reasonable assurance of the safety and effectiveness of pedicle screw spinal systems:

(1) Compliance with materials standards, such as ASTM F136, F138, and F1314 (serve to control risks of implant breakage, particulate debris, and metal toxicity); (2) Compliance with mechanical testing standards, such as ASTM PS-5-94, (serves to control risks of implant breakage, loss of fixation, loss of alignment, and loss of reduction); (3) Compliance with biocompatibility testing standards, such as "Tripartite Biocompatibility Guidance for Medical Devices" (9/86) and International Standards Organization (ISO) 10993-1 (serve to control biocompatibility concerns, such as metal toxicity and long-term theoretical risks of carcinogenicity); and (4) Compliance with special labeling requirements (serve to control risks such as nerve root or spinal cord injury, dural tears, vascular injury, visceral injury, pedicle fracture, vertebral body penetration, pseudarthrosis, and loss of fixation and alignment, by adequately warning physicians of potential risks related to the use of the device). For example, the following labeling would be required:

Warning: The safety and effectiveness of pedicle screw spinal systems have not been determined for spinal conditions other than those with significant mechanical instability or deformity requiring fusion with instrumentation. These include significant

mechanical instability secondary to spondylolisthesis, vertebral fractures and dislocations; scoliosis, kyphosis, spinal tumors, and pseudarthrosis resulting from previously unsuccessful fusion attempts.

Warning: Implantation of pedicle screw spinal systems is a technically demanding surgical procedure with a significant potential risk of serious injury to patients. This procedure should only be performed by surgeons with adequate training and experience in both the specific surgical technique and use of the specific products to be implanted.

(5) Conduction of postmarket surveillance (PMS) studies for pedicle screw spine systems as a mechanism to address issues related to device specific design differences, surgical techniques, and device usage. Because complications most frequently occur intraoperatively or early post-operatively, yet important common complications occur late post-operatively, a potential PMS study design might include the first 1000 subjects evaluated for intraoperative and early complications and the first 100 subjects evaluated for a minimum of 2 years for late complications.

The agency invites comments on special controls, including labeling statements, which are appropriate to mitigate the risks from use of these devices as they are proposed to be reclassified.

#### *B. Indications for Use*

Spinal instability is defined in terms of real or potential neural dysfunction as measured by the degree of structural damage to the vertebral column. Instability has also been defined in terms of fracture patterns or neurologic deficit (Refs. 17 and 58), or excessive sagittal plane translation on flexion-extension radiographs or spondylolisthesis (Ref. 19). Spinal deformities include structural deformities, such as scoliosis, kyphosis, lordosis, and severe spondylolisthesis.

Fusion of the thoracic, lumbar, and sacral spine is often necessary in the treatment of disorders that involve instability and deformity. Fusion provides permanent stabilization of the involved unstable motion segments and correction of structural deformities, and prevents the long-term sequelae of these disorders.

Clinically, all entities that require fusion, either to treat acute or chronic instability or to correct a spinal deformity, may be indications for the use of adjunctive spinal instrumentation. Spinal instrumentation, including anterior instrumentation systems and posterior hook-rod, sublaminar wire-rod, or pedicle screw-based instrumentation

systems, is used as an adjunct to fusion by immobilizing and stabilizing the involved vertebral motion segments until fusion occurs. Successful fusion is dependent on the maintenance of spinal alignment and elimination of motion at the fusion site. Spinal instrumentation systems are simply contrivances that promote fusion by providing immobilization and stabilization between intervertebral motion segments.

Mechanically, the stabilization of the involved motion segments and maintenance of alignment are accomplished by all types of spinal instrumentation systems by attaching anchors to vertical supporting members (Ref. 13). The posterior hook-rod and posterior sublaminar wire-rod device systems provide mechanical stabilization of the vertebrae with longitudinal rods attached to the laminae or spinous processes via hooks or wires. The anterior plate-screw-cable fixation devices provide stabilization with longitudinal plates or cables attached to the vertebral bodies via screws placed anteriorly or laterally. Similarly, pedicle screw spinal systems provide stabilization of vertebrae with longitudinal plates or rods attached to the vertebral bodies via screws through the pedicles. Mechanical testing has demonstrated that the pedicle screw spinal systems has equivalent or superior mechanical characteristics, such as static and fatigue strength, when compared to asti class II posterior hook-rod and anterior plate-screw-cable spinal devices (see section III.A.2. of this document). In addition, the rigidity of the vertebrae instrumented with pedicle screw spinal systems is greater than when instrumented with the other device systems (see section III.A.2. of this document). In vivo studies have demonstrated that the strength of the fusion is directly related to the rigidity of the spinal instrumentation (Ref. 123). Clinical studies also have verified that the rate of successful fusion is related to the rigidity of the spinal instrumentation (Ref. 202).

FDA believes that the indications for use of asti devices, as described in 21 CFR 888.3050 and 888.3060, are comparable to the proposed indications for pedicle screw spinal systems. Currently, the class II asti posterior hook-rod, sublaminar wire-rod, sacral screw-rod, and iliac screw-rod fixation devices, "Spinal interlaminar fixation orthoses," are used to "straighten and immobilize the spine to allow bone grafts to unite and fuse the vertebrae together" (21 CFR 888.3050). The intended use is "primarily in the treatment of scoliosis (a lateral curvature of the spine), but it also may

be used in the treatment of fracture or dislocation of the spine, grades 3 and 4 of spondylolisthesis (a dislocation of the spinal column), and lower back syndrome." (An exclusion of lower back syndrome is addressed below). The class II asti anterior plate-screw-cable fixation devices, "Spinal intervertebral body fixation orthosis," are "used to apply a force to a series of vertebrae to correct 'sway back,' scoliosis (lateral curvature of the spine), or other conditions" (21 CFR 888.3060).

Scoliosis is a three-plane spinal deformity, but should also be considered a growth abnormality and a chronic instability. The predominant feature in scoliosis is a lateral curvature of the thoracic and lumbar vertebrae in the coronal plane, but is also accompanied by sagittal plane and rotational deformities. Untreated severe scoliosis can cause severe cosmetic deformity, degenerative facet joint and intervertebral disc disease, paraplegia, right heart failure, and death, and can compromise pulmonary function.

Spinal fractures and dislocations result in loss of bony or ligamentous integrity that cause spinal instability. Untreated traumatic spinal instability may lead to progressive spinal deformity, nonunion, pain, progressive neurologic deficit, and traumatic spinal stenosis.

Spondylolisthesis, whether degenerative or severe, is generally regarded as a chronic instability caused by loss of the structural integrity of posterior element structures, such as the pars interarticularis, as well as the intervertebral disc. Spondylolisthesis results in a chronic, sometimes progressive, anterior subluxation of the superior vertebra over the inferior vertebra. This may be a result of congenital vertebral anomalies (e.g., deficiency of the facets), acquired defects (e.g., traumatic pars defects, pedicle or facet fractures), metabolic bone diseases (e.g., osteogenesis imperfecta, osteoporosis), or degenerative processes (e.g., degenerative disc disease). Spondylolisthesis may cause severe back and leg pain, postural deformity, gait abnormalities due to hamstring tightness, and progressive neurologic deficits.

FDA believes that, for the purposes of device classification, all of the above indications can be categorized as acute and chronic instabilities and deformities.

Lower back syndrome is an ill-defined disorder and is not considered to be included in the indications of acute and chronic instabilities and deformities. Sway back, an obsolete term for

lordosis, is a congenital or developmental sagittal plane deformity. Although 21 CFR 888.3060 states that the asti device is also indicated for "other conditions" that were not specified, the "other conditions" involve instability or a deformity in which fusion is indicated. Both of these asti devices are used as adjuncts to spinal fusion, providing immobilization and stabilization of the spinal segments while fusion takes place. Except for this ill-defined "lower back syndrome," all these indications constitute acute and chronic instabilities or deformities. The common purpose of the treatment of these clinical entities is to prevent the short-term and long-term sequelae of instability and deformity, such as progressive neurologic deficit, severe pain, severe cosmetic deformity, pulmonary and cardiovascular compromise, and even death.

Acute and chronic instabilities or deformities therefore include scoliosis, fractures, dislocations, and spondylolisthesis, but may also include spinal tumors, pseudarthrosis, as well as kyphotic deformities. An extensive laminectomy for spinal stenosis, foraminal stenosis, or other indications may cause iatrogenic spinal instability by removing critical stabilizing posterior element structures (Refs. 78 and 118). Benign and malignant tumors cause instability of the spine by compromising the structural integrity of the anterior, middle, or posterior columns of the spine (Refs. 31, 94, 114, 118, and 126). Segmental defects or loss of posterior elements following tumor resection require instrumentation and fusion to reestablish spinal stability and prevent neurologic injury. The pathogenesis of kyphosis deformities are fracture, inflammation, tumor, congenital malformation, and laminectomy (Refs. 25, 36, and 118). The goal of treatment is immediate and long-term stability, nerve and cord decompression, and correction of angulation. Pseudarthrosis, or failure to achieve a successful fusion, causes symptomatic instability at the motion segment (Refs. 104, 169, and 202).

FDA believes that sufficient clinical data exist to justify including other indications such as scoliosis, spinal tumors, and failed previous fusion attempts (pseudarthrosis) in the intended use of the pedicle screw spinal system. The medical literature and data from IDE clinical investigations demonstrate that the device can effectively stabilize the spine and adequately maintain spinal alignment while fusion takes place, and provide adequate evidence that the device can safely and effectively treat these

conditions (Ref. 66). FDA believes that the risks associated with the use of pedicle screw spinal systems intended to provide immobilization and stabilization of spinal segments as an adjunct to fusion in the treatment of these acute and chronic instabilities and deformities are similar to those of the commercially available device systems (21 CFR 888.3050 and 888.3060) and that these rates are clinically acceptable (Ref. 66). FDA believes that the clinical data from the IDE clinical investigations and the medical literature adequately support the safety and effectiveness of pedicle screw spinal systems for these additional indications (Ref. 66). Moreover, FDA recognizes that these indications for use are similar to those of commercially available class II spinal fixation devices, such as the spinal interlaminar fixation orthosis classified under 21 CFR 888.3050 and the spinal intervertebral body fixation orthosis classified under 21 CFR 888.3060.

FDA believes the medical literature is also supportive of the use of pedicle screw spinal systems in the treatment of acute and chronic instabilities and deformities. As described above in section III.B. of this document, the rates of clinical complications related to the use of pedicle screw spinal systems in the treatment of acute and chronic instabilities and deformities are comparable to those for existing class II devices in terms of mechanical failures (Refs. 3, 5, 19, 22, 24, 32, 35, 37, 43, 47, 50, 51, 58, 59, 60, 73, 77, 79, 87, 89, 90, 94, 95, 107, 109, 110, 113, 116, 122, 125, 150, 151, 152, 162, 163, 164, 173, 183, 185, 186, 187, 191, 192, 193, and 205), soft tissue injuries (Refs. 25, 26, 27, 37, 46, 47, 49, 60, 74, 106, 112, 113, 126, 127, 147, 153, 183, 185, 187, 191, and 192), pseudarthrosis (Refs. 3, 17, 22, 24, 25, 32, 34, 35, 36, 37, 47, 50, 80, 96, 125, 126, 153, 154, 169, 173, 174, 194, and 205), and reoperation rates (Refs. 50, 51, 60, 74, 86, 119, and 173). The clinical performance is also comparable to existing spinal devices in terms of fusion rates (Refs. 1, 22, 27, 37, 49, 55, 66, 80, 86, 95, 96, 109, 110, 113, 125, 163, 169, 173, 183, 185, 186, 187, 192, 200, 201, and 202), rates of successful pain (Refs. 2, 18, 25, 27, 37, 80, 86, 95, 97, 109, 110, and 147), function (Refs. 51, 109, 119, 147, 173, and 206), and neurological outcomes (Refs. 39, 49, 55, 80, 90, 107, 153, 154, and 164).

FDA also recognizes the unique benefits of pedicle screw spinal systems compared to existing spinal instrumentation systems in the treatment of certain conditions involving severe instability or deformity. The rigid, segmental, three-column fixation achieved with pedicle

screw instrumentation allows successful fixation of severely unstable spines in cases of tumor (Refs. 31, 77, 94, and 114), severe fracture-dislocation (Refs. 2, 4, 17, 35, 46, 53, 58, 59, 73, 107, 108, 128, 130, 140, 153, 154, 160, and 178), and severe spondylolisthesis (Refs. 5, 27, 77, 81, 82, 83, 147, 169, and 175). In addition, the pedicle screw spinal systems provide the only means of posterior attachment of instrumentation in cases of iatrogenic instability in which the absence of the posterior elements precludes the use of existing posterior instrumentation systems, which require laminae or spinous processes for attachment to the spine (Refs. 113 and 118).

FDA did not find sufficient literature or other clinical data to support use of the device in the treatment of low back pain. FDA has determined that low back pain and other conditions not categorized as an acute or chronic instability or deformity should not be included in the indications for use unless further data justify their inclusion. Thus, if the device has such indications for use, the device is a class III device.

### C. Associated Risks

The risks associated with the use of pedicle screw spinal systems include implant breakage, loss of fixation, nerve root or spinal cord injury, dural tears, vascular injury, visceral injury, pedicle fracture, vertebral body penetration, pseudarthrosis, loss of alignment or reduction, and symptomatic hardware requiring removal. FDA has determined that these risks are comparable to those associated with the use of the existing class II spinal fixation devices described in §§ 888.3050 888.3060. FDA agrees with the panel that the risks to health associated with the use of the device are reasonably well understood and can be adequately controlled through the application of special controls.

### VI. References

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#### VII. Environmental Impact

The agency has determined under 21 CFR 25.24(a)(8) and (e)(2) that this action is of a type that does not individually or cumulatively have a significant effect on the human environment. Therefore, neither an environmental assessment nor an environmental impact statement is required.

#### VIII. Analysis of Impacts

FDA has examined the impacts of the proposed rule under Executive Order 12866 and the Regulatory Flexibility Act (Pub. L. 96-354). Executive Order 12866 directs agencies to assess all costs and benefits of available regulatory alternatives and, when regulation is necessary, to select regulatory approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity). The agency believes that this proposed rule is consistent with the regulatory philosophy and principles identified in the Executive Order. In addition, the

proposed rule is not a significant regulatory action as defined by the Executive Order and so is not subject to review under the Executive Order.

The Regulatory Flexibility Act requires agencies to analyze regulatory options that would minimize any significant impact of a rule on small entities. Because this proposal would reduce a regulatory burden by exempting manufacturers of devices subject to the rule from the requirements of premarket approval, the agency certifies that the proposed rule will not have a significant economic impact on a substantial number of small entities. Therefore, under the Regulatory Flexibility Act, no further analysis is required.

#### IX. Comments

Interested persons may, on or before January 2, 1996 submit to the Dockets Management Branch (address above) written comments regarding this proposal. Two copies of any comments are to be submitted, except that individuals may submit one copy. Comments are to be identified with the name of the device and the docket number found in brackets in the heading of this document. Received comments may be seen in the office above between 9 a.m. and 4 p.m., Monday through Friday.

#### List of Subject in 21 CFR Part 888

Medical devices.

Therefore, under the Federal Food, Drug, and Cosmetic Act and under authority delegated to the Commissioner of Food and Drugs, it is proposed that 21 CFR part 888 be amended as follows:

#### PART 888—ORTHOPEDIC DEVICES

1. The authority citation for 21 CFR part 888 continues to read as follows:

Authority: Secs. 501, 510, 513, 515, 520, 701 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 351, 360, 360c, 360e, 360j, 371).

2. New § 888.3070 is added to subpart D to read as follows:

##### § 888.3070 Pedicle screw spinal system.

(a) *Identification.* A pedicle screw spinal system is a multiple component device, made of alloys such as 316L stainless steel, 316LVM stainless steel, 22Cr-13Ni-5Mn stainless steel, unalloyed titanium, and Ti-6Al-4V, that allows the surgeon to build an implant system to fit the patient's anatomical and physiological requirements. Such a spinal implant assembly consists of anchors (e.g., bolts, hooks, and screws); interconnection mechanisms incorporating nuts, screws, sleeves, or

bolts; longitudinal members (e.g., plates, rods, and plate/rod combinations); and transverse connectors. The device is intended to provide immobilization and stabilization of spinal segments in the treatment of significant medical instability or deformity requiring fusion with instrumentation including significant medical instability secondary to spondylolisthesis, vertebral fractures, and dislocations, scoliosis, kyphosis, spinal tumors, and pseudarthrosis resulting from unsuccessful fusion attempts.

(b) *Classification.* Class II (special controls).

Dated: September 29, 1995.

D.B. Burlington,

Director, Center for Devices and Radiological Health.

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BILLING CODE 4160-01-P

#### DEPARTMENT OF JUSTICE

#### 28 CFR Part 16

[AAG/A Order No. 110-95]

#### Exemption of Records System Under the Privacy Act

AGENCY: Department of Justice.

ACTION: Proposed rule.

**SUMMARY:** The Department of Justice, Bureau of Prisons (Bureau), proposes to exempt a Privacy Act system of records from the following subsections of the Privacy Act: (c) (3) and (4), (d), (e)(1), (e)(2), (e)(3), (e) (5) and (8), and (g). This system of records is the "Access Control Entry/Exit System (JUSTICE/BOP-010)."

The exemptions are necessary to preclude the compromise of institution security, to ensure the safety of inmates, Bureau personnel and the public, to protect third party privacy, to protect law enforcement and investigatory information, and/or to otherwise ensure the effective performance of the Bureau's law enforcement functions.

**DATES:** Submit any comments by November 3, 1995.

**ADDRESSES:** Address all comments to Patricia E. Neely, Program Analyst, Systems Policy Staff, Justice Management Division, Department of Justice, Washington, DC 20530 (Room 850, WCTR Building).

**FOR FURTHER INFORMATION CONTACT:** Patricia E. Neely, Program Analyst, Systems Policy Staff, Justice Management Division, (202) 616-0178.

**SUPPLEMENTARY INFORMATION:** In the notice section of today's Federal