Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-3110

Timothy G. Mitchell
Vice President, Operations
Arkansas Nuclear One

2CAN110801

November 13, 2008

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request
Technical Specification Change To Modify RCS Flow Verification
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) hereby requests the following amendment for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change will modify Technical Specification (TS) 3.3.1.1, Reactor Protective Instrumentation, specifically Table 4.3-1 and associated Notes 7 and 8, to clarify and streamline Reactor Coolant System (RCS) flow verification requirements associated with the Departure from Nucleate Boiling Ratio (DNBR) reactor trip signal.

The proposed change will allow a more accurate Reactor Coolant Pump (RCP) differential pressure based flow indication, as calculated by the Core Operating Limits Supervisory System (COLSS), to be used as the calibration standard at all surveillance intervals. The proposed change also combines the current shiftly and monthly RCS flow verification into one Surveillance Requirement (SR) to be performed on a once per shift basis. Enhancements are included to better describe the flow data comparisons. In addition, discussions of uncertainty measurements are removed from the SR and relocated to the associated TS Bases.

The proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c) and it has been determined that the changes involve no significant hazards consideration. The bases for these determinations are included in the attached submittal.

The proposed change does not include any new commitments.

Entergy requests approval of the proposed amendment by August 1, 2009. Once approved, the amendment shall be implemented within 90 days.

A001
NRR

If you have any questions or require additional information, please contact Dale James at 479-858-4619.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 13, 2008.

Sincerely,

TGM/dbb

Attachments:
1. Analysis of Proposed Technical Specification Change
2. Proposed Technical Specification Changes (mark-up)
3. Markup of Technical Specification Bases (information only)

cc: Mr. Elmo E. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

U. S. Nuclear Regulatory Commission
Attn: Mr. Alan B. Wang
MS O-7 D1
Washington, DC 20555-0001

Mr. Bernard R. Bevill
Director Division of Radiation
Control and Emergency Management
Arkansas Department of Health & Human Services
P.O. Box 1437
Slot H-30
Little Rock, AR 72203-1437

Attachment 1

2CAN110801

Analysis of Proposed Technical Specification Change

1.0 DESCRIPTION

This letter is a request to amend Operating License NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2).

The proposed change will modify Technical Specification (TS) 3.3.1.1, Reactor Protective Instrumentation, specifically Table 4.3-1 and associated Notes 7 and 8, to clarify and streamline requirements for, and improve the accuracy of, Reactor Coolant System (RCS) flow verifications associated with the Departure from Nucleate Boiling Ratio (DNBR) reactor trip signal.

2.0 PROPOSED CHANGE

ANO-2 TS 3.3.1.1, Reactor Protective Instrumentation, Table 4.3-1 is revised to delete the monthly RCS flow verification associated with Functional Unit 10, DNBR – Low. The table note associated with this monthly Surveillance Requirement (SR) is also deleted (specifically, Note 8). The table note associated with the shiftly verification of RCS flow, Note 7, is modified to ensure appropriate flow comparisons are completed to ensure the RCS flow rate used in the Core Protection Calculators (CPCs) is conservative with respect to the measured RCS flow rate.

In addition, instrument uncertainty information is relocated from the SR to the associated TS Bases. A markup of the TS Bases is included in Attachment 3 for information only. The TS Bases will be revised in accordance with the TS Bases Control Program described in TS 6.5.14 as part of the standard TS amendment implementation process following NRC approval of this aforementioned TS change.

3.0 BACKGROUND

Departure from nucleate boiling or DNB is defined as the rate of heat transfer per unit area at which a rapid decrease in the convective heat transfer coefficient occurs, making conduction and radiation the major modes of heat transfer. DNBR is the ratio of the heat flux required to reach DNB divided by the actual heat flux. In other words, a DNBR of 1.0 indicates that the point of DNB has been reached.

In order to prevent DNB, the ANO-2 TSs require DNBR to be maintained ≥ 1.25 during operation in Modes 1 and 2 (reactor critical). In order to ensure this limit is not exceeded, Combustion Engineering (CE) plants like ANO-2 have four channels of installed CPCs. The CPCs provide two of the ten reactor trip signals within the Reactor Protective System (RPS), one of which is a trip on low DNBR at a value ≥ 1.25. To support the DNBR and other calculations, the CPCs include a primary coolant mass flow algorithm that computes a normalized mass flow rate (i.e., the fraction of design mass flow rate) from the speeds of the four Reactor Coolant Pumps (RCPs), the specific volume of the primary coolant and a correction based on hot leg temperature. This normalized mass flow rate is conservatively calibrated with respect to independent measurements of mass flow rate using Type I addressable constant FC1.

Uncertainties associated with the CPC calculation of the normalized mass flow rate and the calibration of CPC determined flow using independent measurements are included in the determination of Type II addressable constant BERR1, according to the methodology described in CEN-356(V)-P-A. Type I addressable constants are those expected to change frequently during plant operation and include power and flow calibration constants, the azimuthal power tilt allowance and pretrip alarm setpoints. Type II addressable constants are not expected to change frequently during the cycle and include shape annealing matrix constants, planar radial peaking factor setpoints, trip setpoints and uncertainty parameters. Administrative controls including procedures and a key switch ensure that addressable constants are properly maintained.

The Core Operating Limits Supervisory System (COLSS) consists of process instrumentation and algorithms used to continually monitor the Limiting Conditions for Operation (LCOs) on peak linear heat rate, DNBR, total core power, and azimuthal power tilt. COLSS serves to monitor reactor core conditions in an efficient manner and provides indication and alarm functions to aid the operator in maintenance of core conditions within the TS LCOs. As with CPCs, COLSS contains an algorithm that computes reactor coolant system flow. The COLSS flow rate however, uses RCP differential pressure instrumentation as the primary input. The relationship between RCP differential pressure, rotational speed and volumetric flow rate is expressed in pump characteristic curves that have been determined for each pump by the manufacturer through calibration measurements. The COLSS algorithm first calculates the volumetric flow rate from measured differential pressure, pump speed and cold leg temperatures. COLSS then determines the mass flow rate using the volumetric flow rate and cold leg specific volume determined using pressure and cold leg temperature instrumentation. Bias constants associated with the volumetric flow rate determined for each RCP are included in the COLSS algorithm to allow for calibration.

At ANO-2, compliance with current surveillance requirements stated in TS Table 4.3-1 Notes 7 and 8 has ultimately been based on an offline calorimetric calculation of the RCS mass flow rate that utilizes hot and cold leg temperature instrumentation, pressurizer pressure instrumentation, and secondary calorimetric power. During monthly surveillances associated with Note 8, the COLSS indicated flow rate is verified conservative with respect to the calorimetric flow rate and the CPC indicated flow rate is verified conservative with respect to COLSS flow rate. COLSS flow bias constants and CPC addressable constant FC1 are changed, as necessary, to achieve the required relationship between indicated and measured flow rates. During shiftly surveillances associated with Note 7, the CPC indicated flow rate is verified conservative with respect to either COLSS or calorimetric flow (typically COLSS).

The calorimetric method described above, because it relies on hot leg temperature instrumentation, can be susceptible to flow streaming effects (temperature stratification). At ANO-2, these effects result in the calorimetric flow measurements, and subsequent calibrations of COLSS and CPC indicated flow rates, being overly conservative.

The use of differential pressure instrumentation and lack of reliance on hot leg temperatures makes the COLSS flow indication the most stable and accurate flow indication available, provided calibration constants are fully validated. Validation of the calibration constants needed to qualify the COLSS flow indication as a wholly independent calibration standard was recently performed for the first time at ANO-2.

Based on the recently completed validations of the COLSS flow rate algorithm and calibration constants, Entergy proposes to allow use of the pump differential pressure based COLSS flow to perform all TS required verifications of RCS total flow rate indicated by CPCs. Since use of the validated COLSS flow at all surveillance intervals would result in identical monthly and shiftly surveillances, it is also proposed that the monthly surveillance requirement be deleted. A technical evaluation of the proposed change follows.

The above describes RCS flow measurement and monitoring for the purpose of maintaining initial DNBR margin for transients and trip decisions. RCS flow is also measured and monitored to ensure the minimum initial flow assumed in safety analyses is available, per TS 3.2.5, RCS Flow Rate. TS 3.2.5 does not specify a measurement method to be used in meeting the surveillance requirement. No changes to TS 3.2.5 are proposed. A flow measurement uncertainty for use in meeting the TS 3.2.5 surveillance requirements with the newly validated COLSS flow algorithm has been determined.

Further detail relating to the CPCs may be found in Section 7.2.1.1.2.5 of the ANO-2 Safety Analysis Report (SAR). Details regarding COLSS may be found in SAR Section 7.7.1.3.

4.0 TECHNICAL ANALYSIS

The current TS requires monthly calibration of the CPC flow rate to an offline measurement of flow using the calorimetric method. Flow streaming in the RCS hot legs at ANO-2 has resulted in the offline calorimetric flow measurement being excessively conservative (i.e. low). When the offline calorimetric flow measurement is used as the calibration standard, it introduces an unnecessary conservative bias into the CPC flow rate calibration and DNBR calculations. Allowing use of the reactor coolant pump differential pressure instrumentation (COLSS determined flow) as the calibration standard at all times provides a more accurate calibration standard since it is not affected by streaming. The calorimetric flow method will be retained as an alternate calibration standard and can be used when COLSS is out of service.

The COLSS flow measurement algorithm constants have been validated using manufacturer's pump casing curves, validated calorimetric flow measurements (from early cycles less affected by flow streaming) and process inputs, as well as a detailed simulation of the RCS flow. This validation was intended to be a one-time effort designed to qualify the COLSS indicated flow rate as a wholly independent calibration standard. Further validation or calibration of the COLSS algorithm will not be required unless reactor coolant pump hardware or instrumentation changes occur. Uncertainty analyses have also been performed to account for process uncertainties, instrumentation uncertainties and the uncertainty associated with the one-time adjustment of the COLSS flow algorithm constants described above. Uncertainties associated with using calorimetric flow measurements as a calibration standard were previously documented and are not affected.

Regardless of the calibration standard applied (differential pressure based or calorimetric based), the methodology for statistical combination of uncertainties described in CEN-356(V)-P-A allows the flow measurement uncertainty to be included in the calculation of CPC addressable uncertainty constant BERR1 such that the CPC DNBR calculation will remain conservative at a 95/95 probability/confidence level. The value of BERR1 currently installed in CPCs already incorporates a flow measurement uncertainty that bounds the uncertainty of the validated COLSS flow algorithm. As previously mentioned, a flow measurement uncertainty for use in meeting the TS 3.2.5 surveillance requirements with the newly validated COLSS flow algorithm has also been determined.

Based on the above, the monthly SR as described in Note 8 to TS Table 4.3-1 is deleted. As required by Note 7 to TS Table 4.3-1, the CPC flow verifications will continue to take place on a once per 12-hour basis, normally using the COLSS RCP Δp flow measurement when available, and using the calorimetric flow measurement when COLSS is not available.

Note 7 is also revised to state that the verification is performed using *measured* flow vice *actual* flow. Since the CPC flow measurement uncertainty is included in the calculation of the CPC DNBR uncertainty addressable constant BERR1 (as described in Reference 1), it is appropriate to verify that the RCS total flow rate as indicated by each CPC is less than or equal to the measured RCS total flow rate instead of the actual RCS total flow rate. This change is considered a clarification only.

The reference to the flow measurement uncertainty is relocated from Note 7 to the associated TS Bases to improve clarity and allow further detail to be included (Attachment 3). This includes removing reference to the BERR1 uncertainty addressable constant from Note 7. Reference to the CPC flow adjustment addressable constant FC1 is added since it is directly applicable to performance of the calibration to the measured flow. This is an editorial change only.

5.0 REGULATORY ANALYSIS

5.1 Applicable Regulatory Requirements/Criteria

The proposed change has been evaluated to determine whether applicable regulations and requirements continue to be met.

General Design Criteria (GDC) 20, Protection System Functions, requires automatic operation of appropriate systems, including the reactivity control systems, to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded as a result of anticipated operational occurrences, and to sense accident conditions and to initiate the operation of systems and components important to safety. The Core Protection Calculators (CPC) initiated reactor trip on a low Departure from Nucleate Boiling Ratio (DNBR) signal is part of the Arkansas Nuclear One, Unit 2 (ANO-2) Plant Protective System (PPS) used to comply with this GDC. In addition, DNBR is considered a Safety Limit as described in and controlled by TS 2.1.1.1. The proposed change continues to support the CPC DNBR function with regard to meeting the GDC and all TS requirements. As discussed previously, the use of Reactor Coolant Pump (RCP) differential pressure flow measurement to complete CPC flow constant verifications is more accurate than using the calorimetric flow measurement and prevents unnecessary conservatisms from being added into the CPC DNBR algorithm. Based on these considerations, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will continue to be conducted in accordance with the site licensing basis, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

In conclusion, Entergy has determined that the proposed change does not require any exemptions or relief from regulatory requirements, other than the TS, and does not affect conformance with any GDC differently than described in the Safety Analysis Report (SAR).

5.2 No Significant Hazards Consideration

A change is proposed to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TSs) to delete the monthly requirement to compare and adjust the Core Protection Calculator (CPC) Reactor Coolant System (RCS) flow using a calorimetric flow measurement. The CPC flow verification will continue to take place on a shiftly (once per 12 hour) basis, normally using the Core Operating Limits Supervisory System (COLSS) Reactor Coolant Pump (RCP) differential pressure (Δp) flow measurement when COLSS is available, and using the aforementioned calorimetric flow measurement when COLSS is unavailable.

In addition to the above, a reference to the CPC flow adjustment addressable constant FC1 is added and the reference to actual flow is changed to measured flow, which is more appropriate. These changes are generally editorial in nature and have no impact on plant function, nuclear safety, or the safety of the public. Therefore, these changes are not evaluated further below.

Finally, the reference to the flow measurement uncertainty and the CPC addressable constant BERR1 is relocated to the associated TS Bases and will be controlled in accordance with the TS Bases Control Program provided in TS 6.5.14.

Entergy Operations, Inc. has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The CPC reactor protective function is not considered an accident initiator. The primary function is to initiate an automatic reactor trip signal when specific plant conditions are reached, thereby limiting the consequences of an accident. The proposed change acts to eliminate unnecessary conservatisms and accordingly increase operational margin by eliminating the requirement to use calorimetric flow measurement in the CPC flow verification. This method of verification will normally only be used in the future during periods when the COLSS RCP Δp flow measurement is unavailable. Regardless of the method of verification used, the CPC will continue to be verified to have an indicated RCS flow equal to or conservative relative to the measured RCS flow on a once per 12-hour basis. In so doing, the CPC will continue to act to generate a reactor trip on low DNBR as originally designed in order to ensure the DNBR reactor core Safety Limit is not exceeded.

   The relocation of measurement uncertainty references to the TS Bases does not reduce the requirements to account for uncertainties in any Limiting Safety System Setting (LSSS) designed to protect reactor core Safety Limits. The necessary uncertainties will continue to be applied as required and will be controlled in accordance with TS 6.5.14, Technical Specification Bases Control Program, and station procedures.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change does not result in any physical plant modifications or changes in the way the plant is operated. In addition, the CPCs are unrelated to any type of accident initiator previously evaluated.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed change increases operating margin when the COLSS RCP Δp flow measurement is available for use while unaffecting the CPC ability to initiate an automatic reactor trip on low DNBR prior to the DNBR reactor core safety limit being exceeded. Relocating the references to measurement uncertainties to the TS Bases likewise has no impact on the CPC design function and the uncertainties will continue to be applied as required and controlled in accordance with TS 6.5.14, Technical Specification Bases Control Program, and station procedures.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 PRECEDENCE

The RCP differential pressure method of flow measurement is currently employed at Calvert Cliffs Units 1 and 2, and Palo Verde Units 1, 2, and 3. These plants rely on the constancy of the pump head versus flow characteristics. This process is more reliable and is not overly conservative.

7.0 REFERENCE

1. CEN-356(V)-P-A Revision 01-P-A

Attachment 2

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Proposed Technical Specification Changes (mark-up)

TABLE 4.3-1

REACTOR PROTECTION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. Manual Reactor Trip	N.A.	N.A.	S/U (1)	N.A.
2. Linear Power Level – High	S	D (2,4) M (3,4) Q (4)	TA (10)	1,2
3. Logarithmic Power Level – High	S	R (4)	TA (10) S/U (1)	1,2,3,4,5 and *
4. Pressurizer Pressure – High	S	R	TA (10)	1,2
5. Pressurizer Pressure – Low	S	R	TA (10)	1,2,3*,4*,5*
6. Containment Pressure – High	S	R	TA (10)	1,2
7. Steam Generator Pressure – Low	S	R	TA (10)	1,2,3*,4*,5*
8. Steam Generator Level – Low	S	R	TA (10)	1,2
9. Local Power Density – High	S	D (2,4) R (4,5)	TA (10) R (6)	1,2
10. DNBR – Low	S	S (7), D (2,4), ~~M (8),~~ R (4,5)	TA (10) R (6)	1,2
11. Reactor Protection System Logic	N.A.	N.A.	TA (10)	1,2,3*,4*,5*
12. Reactor Trip Breakers	N.A.	N.A.	M	1,2,3*,4*,5*
13. Core Protection Calculators	S	D (2,4) R (4,5)	TA (9,10) R (6)	1,2
14. CEA Calculators	S	R	TA (10) R (6)	1,2

(7) - Above 70% of RATED THERMAL POWER, verify that the total RCS flow rate as indicated by each CPC is less than or equal to the ~~actual~~ RCS total flow rate determined by either using the reactor coolant pump differential pressure instrumentation ~~(conservatively compensate for measurement uncertainties)~~ or by calorimetric calculations ~~(conservatively compensated for measurement uncertainties)~~ and, if necessary, adjust the CPC flow calibration addressable constant FC1~~flow coefficients~~ such that each CPC indicated flow is less than or equal to the measured~~actual~~ flow rate. ~~The flow measurement uncertainty may be included in the BERR1 term in the CPC and is equal to or greater than 4%.~~

(8) - ~~Above 70% of RATED THERMAL POWER, verify that the total RCS flow rate as indicated by each CPC is less than or equal to the actual RCS total flow rate determined by calorimetric calculations (conservatively compensated for measurement uncertainties).~~Deleted

(9) - The CPC CHANNEL FUNCTIONAL TEST shall include the verification that the correct values of addressable constants are installed in each OPERABLE CPC.

(10) - On a STAGGERED TEST BASIS.

Attachment 3

2CAN110801

Markup of Technical Specification Bases
(information only)

3/4.3.1 and 3/4.3.2 PROTECTIVE AND ENGINEERED SAFETY FEATURES (ESF) INSTRUMENTATION

The OPERABILITY of the protective and ESF instrumentation systems and bypasses ensure that 1) the associated ESF action and/or reactor trip will be initiated when the parameter monitored by each channel or combination thereof reaches its setpoint, 2) the specified coincidence logic is maintained, 3) sufficient redundancy is maintained to permit a channel to be out of service for testing or maintenance, and 4) sufficient system functional capability is available for protective and ESF purposes from diverse parameters.

The OPERABILITY of these systems is required to provide the overall reliability, redundancy and diversity assumed available in the facility design for the protection and mitigation of accident and transient conditions. The integrated operation of each of these systems is consistent with the assumptions used in the accident analyses.

The surveillance requirements specified for these systems ensure that the overall system functional capability is maintained comparable to the original design standards. The periodic surveillance tests performed at the minimum frequencies are sufficient to demonstrate this capability. The triennial~~triannual~~ channel functional testing frequency is to be performed on a STAGGERED TEST BASIS.

The RPS Matrix Logic channels and the Initiation Logic channels are listed as separate functional units in Table 3.3-1 and are grouped together in the corresponding surveillance Table 4.3-1 as a single functional unit listed as Reactor Protection System (RPS) Logic. The RPS Logic contains six Matrix Logic channels and four Initiation Logic channels. For surveillance testing purposes, the RPS Logic is considered to have four channels or n = 4 with respect to STAGGERED TEST BASIS. The associated triennial~~triannual~~ CHANNEL FUNCTIONAL TESTING requirements are performed during the individual channel PPS test. The six RPS Matrix Logic channels are divided up for testing purposes as follows: Matrix AB is tested with channel A, matrices BC and BD are tested with channel B, matrices AC and CD are tested with channel C, and matrix AD is tested with channel D. This testing methodology is supported by the analysis that was performed to extend the surveillance interval to the triennial ~~triannual~~ frequency and also satisfies the STAGGERED TEST BASIS requirements for the RPS Matrix Logic channels.

Table 4.3-1 requires verification (once per 12 hours) that the CPC indicated flow rate is less than or equal to the RCS total flow rate measured using either reactor coolant pump differential pressure instrumentation or calorimetric calculations (see Note 7). This calibration requirement ensures that the CPC calculation of DNBR uses a conservative value of RCS total flow rate. The calibration check is typically performed by comparing CPC and reactor coolant pump differential pressure based COLSS relative mass flows (in terms of the fraction of design flow rate). When COLSS is out of service, the calibration of CPC flow is performed by comparing to a calorimetric calculation of the flow rate. Uncertainties associated with measuring the flow rate are included in the determination of CPC DNBR uncertainty addressable constant BERR1 (using methodology described in CEN-356(V)-P-A). Separate BERR1 constants may be determined for COLSS and calorimetric methods. As applicable, the flow measurement uncertainty accounts for process and instrumentation uncertainties as well as uncertainties associated with calibration of the COLSS flow measurement algorithm based on pump casing curves, validated calorimetric flow measurements and detailed simulations of RCS flow.

Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

First Class M

U.S. NUCLEAR REGULATORY COMMISSION
DOCUMENT CONTROL DESK
ONE WHITE FLINT NORTH
11555 ROCKVILLE PIKE
MAIL STOP O1F13
WASHINGTON, DC 20555-0001