INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA

WAGRAMERSTRASSE 5, P.O. BOX 100, A-1400 VIENNA, AUSTRIA
TELEX: 1-12645, CABLE: INATOM VIENNA, FACSIMILE: 43 222 230184, TELEPHONE: (222) 2360

IN REPLY PLEASE REFER TO:
PRIERE DE RAPPELER LA REFERENCE:

DIAL DIRECTLY TO EXTENSION:
COMPOSER DIRECTEMENT LE NUMERO DE POSTE:

CERTIFICATE

Certified Reference Material for NDA (BWR-1/0,71 %/198,8 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	152.59 ± 0.03
Total U-235 content	(mass in g ± 1 std. error)	:	1.0776 ± 0.0046
U-element concentration	(weight % ± 1 std. error)	:	88.098 ± 0.018
U-235 isot. concentration	(weight % ± 1 std. error)	:	0.7062 ± 0.0030

The material is represented by one short fuel pin of BWR-type containing natural uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-1/0,71 %/198,8 mm on the tube. The pin weighs 290.02 g and has a total length of 445.6 mm. It contains 16 pellets of an average diameter of 10.441 mm, an average length of 12.398 mm, an average density of 10.451 g/cm^3 and an average dish volume of 24.283 mm^3. The pellet stack weighs 173.2 g and has an active length of 198.8 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.83 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

The standard errors are estimates for the dispersion of the assigned values, as derived from experimental designs and calculated by an Analysis of Variance. These standard errors do not include calibration errors which may be common to all laboratories. The fabrication of the fuel pin is documented in a protocol provided by RBU.

Vienna, 1986-09-16

M. Yousif
Acting Head
Data Evaluation Section
Division of Safeguards Evaluation

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Certified Reference Material for NDA (BWR-1/2,00 %/198,0 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	150.59 ± 0.02
Total U-235 content	(mass in g ± 1 std. error)	:	3.0050 ± 0.0013
U-element concentration	(weight % ± 1 std. error)	:	88.116 ± 0.011
U-235 isot. concentration	(weight % ± 1 std. error)	:	1.9955 ± 0.0009

The material is represented by one short fuel pin of BWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-1/2,00 %/198,0 mm on the tube. The pin weighs 286.95 g and has a total length of 442.1 mm. It contains 16 pellets of an average diameter of 10.438 mm, an average length of 12.392 mm, an average density of 10.383 g/cm^3 and an average dish volume of 24.950 mm^3. The pellet stack weighs 170.9 g and has an active length of 198.0 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.83 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (BWR-1/3,80 %/200,2 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	154.10 ± 0.02
Total U-235 content	(mass in g ± 1 std. error)	:	5.8482 ± 0.0034
U-element concentration	(weight % ± 1 std. error)	:	88.105 ± 0.015
U-235 isot. concentration	(weight % ± 1 std. error)	:	3.7952 ± 0.0021

The material is represented by one short fuel pin of BWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-1/3,80 %/200,2 mm on the tube. The pin weighs 291.69 g and has a total length of 445.6 mm. It contains 16 pellets of an average diameter of 10.436 mm, an average length of 12.470 mm, an average density of 10.469 g/cm³ and an average dish volume of 22.017 mm³. The pellet stack weighs 174.9 g and has an active length of 200.2 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.83 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (PWR-1/0,71 %/196,7 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	115.60 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	0.8420 ± 0.0006
U-element concentration	(weight % ± 1 std. error)	:	88.112 ± 0.011
U-235 isot. concentration	(weight % ± 1 std. error)	:	0.7128 ± 0.0005

The material is represented by one short fuel pin of PWR-type containing natural uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked PWR-1/0,71 %/196,7 mm on the tube. The pin weighs 222.42 g and has a total length of 417.0 mm. It contains 13 pellets of an average diameter of 9.104 mm, an average length of 15.052 mm, an average density of 10.480 g/cm^3 and an average dish volume of 19.667 mm^3. The pellet stack weighs 131.2 g and has an active length of 196.7 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.73 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (PWR-1/2,05 %/201,2 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	117.90 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	2.4299 ± 0.0010
U-element concentration	(weight % ± 1 std. error)	:	88.113 ± 0.006
U-235 isot. concentration	(weight % ± 1 std. error)	:	2.0611 ± 0.0008

The material is represented by one short fuel pin of PWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked PWR-1/2,05 %/201,2 mm on the tube. The pin weighs 225.61 g and has a total length of 416.9 mm. It contains 18 pellets of an average diameter of 9.111 mm, an average length of 11.167 mm, an average density of 10.457 g/cm^3 and an average dish volume of 15.367 mm^3. The pellet stack weighs 133.8 g and has an active length of 201.2 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.74 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (PWR-1/3,80 %/197,7 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	115.25 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	4.3739 ± 0.0013
U-element concentration	(weight % ± 1 std. error)	:	88.113 ± 0.012
U-235 isot. concentration	(weight % ± 1 std. error)	:	3.7951 ± 0.0010

The material is represented by one short fuel pin of PWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA calibration purposes within Agency safeguards.

The pin is marked PWR-1/3,80 %/197,7 mm on the tube. The pin weighs 222.55 g and has a total length of 417.0 mm. It contains 18 pellets of an average diameter of 9.110 mm, an average length of 10.993 mm, an average density of 10.425 g/cm³ and an average dish volume of 15.050 mm³. The pellet stack weighs 130.8 g and has an active length of 197.7 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.73 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (BWR-2/0,71 %/198,0 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	151.88 ± 0.03
Total U-235 content	(mass in g ± 1 std. error)	:	1.0726 ± 0.0046
U-element concentration	(weight % ± 1 std. error)	:	88.098 ± 0.018
U-235 isot. concentration	(weight % ± 1 std. error)	:	0.7062 ± 0.0030

The material is represented by one short fuel pin of BWR-type containing natural uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-2/0,71 %/198,0 mm on the tube. The pin weighs 289.11 g and has a total length of 445.5 mm. It contains 16 pellets of an average diameter of 10.441 mm, an average length of 12.398 mm, an average density of 10.451 g/cm^3 and an average dish volume of 24.283 mm^3. The pellet stack weighs 172.4 g and has an active length of 198.0 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.82 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified values:

Total U-content	(mass in g ± 1 std. error)	:	151.30 ± 0.02
Total U-235 content	(mass in g ± 1 std. error)	:	3.0191 ± 0.0014
U-element concentration	(weight % ± 1 std. error)	:	88.116 ± 0.011
U-235 isot. concentration	(weight % ± 1 std. error)	:	1.9955 ± 0.0009

The material is represented by one short fuel pin of BWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-2/2,00 %/199,0 mm on the tube. The pin weighs 288.17 g and has a total length of 445.5 mm. It contains 16 pellets of an average diameter of 10.438 mm, an average length of 12.392 mm, an average density of 10.383 g/cm^3 and an average dish volume of 24.950 mm^3. The pellet stack weighs 171.7 g and has an active length of 199.0 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.83 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified values:

Total U content	(mass in g ± 1 std. error)	:	153.83 ± 0.02
Total U-235 content	(mass in g ± 1 std. error)	:	5.8382 ± 0.0034
U-element concentration	(weight % ± 1 std. error)	:	88.105 ± 0.015
U-235 isot. concentration	(weight % ± 1 std. error)	:	3.7952 ± 0.0021

The material is represented by one short fuel pin of BWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked BWR-2/3,80 %/200,0 mm on the tube. The pin weighs 291.57 g and has a total length of 445.5 mm. It contains 16 pellets of an average diameter of 10.436 mm, an average length of 12.470 mm, an average density of 10.469 g/cm^3 and an average dish volume of 22.017 mm^3. The pellet stack weighs 174.6 g and has an active length of 200.0 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-2) with an external diameter of 12.31 mm; the average cladding thickness is 0.83 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

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Certified Reference Material for NDA (PWR-2/0,71 %/196,4 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	115.34 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	0.8221 ± 0.0006
U-element concentration	(weight % ± 1 std. error)	:	88.112 ± 0.011
U-235 isot. concentration	(weight % ± 1 std. error)	:	0.7128 ± 0.0005

The material is represented by one short fuel pin of PWR-type containing natural uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked PWR-2/0,71 %/196,4 mm on the tube. The pin weighs 222.50 g and has a total length of 416.9 mm. It contains 13 pellets of an average diameter of 9.104 mm, an average length of 15.052 mm, an average density of 10.480 g/cm^3 and an average dish volume of 19.667 mm^3. The pellet stack weighs 130.9 g and has an active length of 196.4 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.73 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

The standard errors are estimates for the dispersion of the assigned values, as derived from experimental designs and calculated by an Analysis of Variance. These standard errors do not include calibration errors which may be common to all laboratories. The fabrication of the fuel pin is documented in a protocol provided by RBU.

Vienna, 1986-09-16

M. Yousif
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Department of Safeguards

INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA

WAGRAMERSTRASSE 5, P.O. BOX 100, A-1400 VIENNA, AUSTRIA
TELEX: 1-12645, CABLE: INATOM VIENNA, FACSIMILE: 43 222 230184, TELEPHONE: (222) 2360

IN REPLY PLEASE REFER TO:
PRIERE DE RAPPELER LA REFERENCE:

DIAL DIRECTLY TO EXTENSION:
COMPOSER DIRECTEMENT LE NUMERO DE POSTE:

CERTIFICATE

Certified Reference Material for NDA (PWR-2/2,05 %/201,3 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	118.07 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	2.4336 ± 0.0010
U-element concentration	(weight % ± 1 std. error)	:	88.113 ± 0.006
U-235 isot. concentration	(weight % ± 1 std. error)	:	2.0611 ± 0.0008

The material is represented by one short fuel pin of PWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked PWR-2/2,05 %/201,3 mm on the tube. The pin weighs 225.59 g and has a total length of 416.8 mm. It contains 18 pellets of an average diameter of 9.111 mm, an average length of 11.167 mm, an average density of 10.457 g/cm^3 and an average dish volume of 15.367 mm^3. The pellet stack weighs 134.0 g and has an active length of 201.3 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.72 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

The standard errors are estimates for the dispersion of the assigned values, as derived from experimental designs and calculated by an Analysis of Variance. These standard errors do not include calibration errors which may be common to all laboratories. The fabrication of the fuel pin is documented in a protocol provided by RBU.

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Certified Reference Material for NDA (PWR-2/3,80 %/197,8 mm)

Certified values:

Total U-content	(mass in g ± 1 std. error)	:	115.34 ± 0.01
Total U-235 content	(mass in g ± 1 std. error)	:	4.3773 ± 0.0013
U-element concentration	(weight % ± 1 std. error)	:	88.113 ± 0.012
U-235 isot. concentration	(weight % ± 1 std. error)	:	3.7951 ± 0.0010

The material is represented by one short fuel pin of PWR-type containing low enriched uranium dioxide. The pin was fabricated at the RBU fuel fabrication facility at Hanau, Fed. Rep. of Germany, and is to be used for NDA-calibration purposes within Agency safeguards.

The pin is marked PWR-2/3,80 %/197,8 mm on the tube. The pin weighs 222.20 g and has a total length of 416.9 mm. It contains 18 pellets of an average diameter of 9.110 mm, an average length of 10.993 mm, an average density of 10.425 g/cm³ and an average dish volume of 15.050 mm³. The pellet stack weighs 130.9 g and has an active length of 197.8 mm. The pellet stack is located in the unmarked part of the pin (right hand side, when reading the identification); its position is engraved on the cladding. The cladding is constituted by a zircaloy tube (Zry-4) with an external diameter of 10.75 mm; the average cladding thickness is 0.73 mm.

The values for the uranium content, the U-235 isotope concentration and the total U-235 content were calculated by averaging measurements made at two Agency's Network Laboratories, namely at the Central Control Laboratory, REZ, CSSR and at the Chemistry Division of UKAEA, Harwell, UK, as well as at the IAEA Safeguards Analytical Laboratory, Seibersdorf, Austria. The measurements were applications of potentiometric and mass-spectrometric methods. The values were justified at the laboratories using primary standard reference materials.

The standard errors are estimates for the dispersion of the assigned values, as derived from experimental designs and calculated by an Analysis of Variance. These standard errors do not include calibration errors which may be common to all laboratories. The fabrication of the fuel pin is documented in a protocol provided by RBU.

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